THE

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OF

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AND

AGRICULTURE.

No. XXXII. SECOND SERIES. Jan. 1805.

Specification of the Patent granted to Thomas Noon, *of Burton-upon-Trent, in the County of Stafford, Watch-maker; for a Thrashing Machine with loose Beaters.*

Dated October 30, 1804.

With a Plate.

TO all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Thomas Noon do hereby declare that my said invention is fully described and ascertained by the drawings in the margin of these presents, and which I explain in manner following; that is to say:

Fig. 1, (Plate V.) is an elevation or side-view of the machine at rest; and Fig. 2, is a plan or bird's-eye-view of the same, of two-horse power, each drawn upon a scale of half an inch to the foot. The same letters on each of the drawings refer to the same parts in each figure. *a*, is a cylinder or drum upon which the loose beaters *b* are hung by means of the pivot ends *c*. *d d*, are two fluted rollers, through which the corn is introduced into the

the machine, to be thrashed from the feeding-board in the common way. These rollers must be pressed towards each other by means of springs, weights, or any other mode, so as to hold the straw sufficiently tight in its passage through them while the beaters separate the corn from it. Underneath these rollers is a trough *f f*, ribbed or fluted within, the whole width of the cylinders, and about one-third of its circumference, against which the beaters strike, and thereby separate the corn from the straw, and deliver both out at the other end of the said trough, where it may pass over, if thought proper, a screen to be winnowed. *g*, is a screw, to raise or fall the trough *f f*, under the cylinder or drum, as circumstances may require, for different sorts of grain. Any other convenient method may be used for this purpose. *h h*, are two wheels for turning the fluted rollers *d d*; the smaller one of which is driven by the wheel *i*, which is connected to the horizontal shaft *k*, Fig. 3, by means of the click-wheel *l*, when it is intended to work the machine by horse, or other superior power. This click-wheel is so constructed that no accident can happen either to the machine or horse should the animal suddenly stop. It consists of a flat iron plate *l*, on which are fixed the two triangular clicks *m m*, the upper part of which is rounded off. Under the clicks are fixed two steel springs *n n*, to keep them up. When the horse or other power drives the horizontal shaft *k*, a cross bar *o* on its end is forced against the square or upright sides of the clicks, and thereby gives motion to the machine. But should the horse suddenly stop, or should the shaft *k*, by any other means, be suddenly checked, the machine would continue its course (from the velocity acquired by the fly-wheel) without injury until it stopped

of

of itself; for the clicks would then meet the bar *o* the contrary way, and slip over it. This contrivance may be applied to considerable advantage in various other kinds of machinery. *p*, is a wheel for giving motion to the cylinder or drum, on the axis of which it is fixed, and which is driven by the wheel *i*. On the other end of the axis a fly-wheel *q* is fixed, for the purpose of steadying the motion of the machine, &c.

I do not think it necessary to mention the various materials of which the machine should be constructed, as every workman must be a competent judge of that matter, and will vary them according to circumstances. The drawings represent a machine of two-horse power, which will cause the cylinder or drum to make about one hundred revolutions in a minute, which velocity may be increased or diminished by altering the number of wheels or cogs on the wheels either belonging to the machine or the horizontal shaft, or by any other well-known means.

The advantages arising from this machine are very considerable, it having less friction than any other that has hitherto come to my knowledge, and consequently it does more work with the same power, and less injury to the straw. It is also less liable to accidents, and when out of order may be repaired by a common workman.

In witness whereof, &c.

Specification of the Patent granted to ARTHUR WOOLF, *of Wood-street, Spa-Fields, in the County of Middlesex, Engineer; for certain Improvements in the Construction of Steam-Engines.* Dated June 7, 1804.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Arthur Woolf do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed as follows; that is to say: I have ascertained by actual experiments, and have applied the same to practice, that as in practice it is found that steam acting with the expansive force of four pounds the square inch, against the safety valve exposed to the atmosphere, is capable of expanding itself to four times the volume it then occupies, and still to be equal to the pressure of the atmosphere; so in like manner steam of the force of five pounds the square inch can expand itself to five times its volume. Masses or quantities of steam of the like expansive force of six, seven, eight, nine, or ten pounds the square inch, can expand itself to six, seven, eight, nine, or ten times its volume, and still be respectively equal to the atmosphere, or capable of producing sufficient action against the piston of a steam engine, to cause the same to rise in the old engine (with a counterpoise) of Newcomen, or to be carried into the vacuous part of the cylinder in the improved engines, first brought into effect by Boulton and Watt; and this ratio is progressive, and nearly, if not entirely uniform; so that steam, the expansive force of twenty, thirty, forty, or fifty pounds, the square inch of a common safety-valve, will expand itself to twenty, thirty, forty, or fifty times its volume; and generally, as to all the intermediate or higher degrees of elastic force, the number

ber of times which steam of any temperature and force can expand itself, being nearly the same as the number of pounds it is able to sustain on a square inch, exposed to the common atmospheric counterpressure; provided always, that the space, place, or vessel, in which it is allowed to expand itself, be at least of as high a temperature, or nearly as high a temperature, as that of the steam before it be allowed room to expand; that is, whatever be the degree of heat necessary to the permanency of steam of the force of twenty pounds the square inch, if steam of that force be employed, the space, place, or vessel in which it is allowed or intended to expand itself, should be of the same temperature or nearly so; and so with steam of any other power, as of thirty, forty, or fifty pounds the square inch; the space, place, or vessel, in which it is to expand, should be at or about the same degree of heat as steam of the force employed requires for its existence; in which case, as I have before stated, steam can expand itself about as many times as the number of pounds it could have sustained on a square inch as aforesaid, before it is allowed to expand or dilate itself. Here, however, it may be necessary to remark, that in stating this ratio, I only speak of the expansion of steam as it can be managed and commanded in practice, and not of the absolute expansion which perhaps might be obtained, if mechanism could be made so perfect as to prevent all escape of steam, and all partial condensation of it and waste of heat; for the real expansive force of steam, I am inclined to believe, from the experiments I have made, increases in a regular ratio a little beyond what I have stated, though I would not recommend that it should be calculated higher in applying it to steam engines, because the difficulty of confining and managing it increases also as the elasticity of the steam is increased, or as its temperature is increased.

And

And here it may be of use to the public to state some facts respecting different degrees of temperature required to bring steam to, and maintain it at different expansive forces above the weight of the atmosphere; because the temperature of the steam indicated by a thermometer, having its bulb in the boiler which produces it, will indicate the expansive force of the steam, without the trouble and inconvenience of changing the weights on the valve, by which its force is regulated for the work intended to be performed by it, and which valve acts as a common safety-valve, so that those who attend the boiler will know with sufficient precision by looking at the thermometer how they ought to feed the fire; and, moreover, the relation between the temperature and the expansive force being known, the danger of accidents from the safety-valve becoming deranged will be lessened, for the workman will naturally be led to notice whether the safety-valve acts freely, when the thermometer has risen to the degree that answers to the weight with which the valve is loaded for working. I have found by actual experiment, setting out from the boiling point, or two hundred and twelve degrees of the thermometer commonly employed in this country, which is that of Fahrenheit, at which degree steam of water is only equal to the pressure of the atmosphere, that, in order to give it an increased elastic force equal to five pounds the square inch, the temperature must be raised fifteen or sixteen degrees, or to about two hundred and twenty-seven and a half, when the steam will have acquired a power to expand itself to five times its volume, and still be equal to the atmosphere, and capable of being applied as such in the working of steam engines according to my said invention. And with regard to various other pressures, temperatures, and expansive forces of steam, the same are shewn in the following table.

Table

Table of the relative pressures *per* square inch. Temperatures and expansibility of steam at degrees of heat above the boiling point of water, beginning with the temperature of steam of an elastic force, equal to five pounds per square inch, and extending to steam able to sustain forty pounds on the square inch.

	Pounds per square inch.		Degrees of heat.		Expansibility.	
Steam of an elastic force	5	requires to be maintained	$227\frac{1}{2}$	and at these respective	5	times its volume, and
predominating over	6	by a temperature equal	$230\frac{1}{4}$	degrees of heat, steam	6	continue equal in elasti-
the pressure of the	7	to about	$232\frac{3}{4}$	can expand itself to	7	city to the pressure of
atmosphere upon a	8		$235\frac{1}{4}$	about	8	the atmosphere.
safety-valve,	9		$237\frac{1}{2}$		9	
	10		$239\frac{1}{2}$		10	
	15		$250\frac{1}{2}$		15	
	20		$259\frac{1}{2}$		20	
	25		267		25	
	30		273		30	
	35		278		35	
	40		282		40	

And so in like manner, by small additions of temperature, an expansive power may be given to steam, to enable it to expand to fifty, sixty, seventy, eighty, ninety, one hundred, two hundred, three hundred, or more times its volume, without any limitation but what is imposed by the frangible nature of every material, of which boilers or other parts of steam engines have been or can be made; and prudence dictates that the expansive force should never be carried to the utmost the materials can bear, but rather be kept considerably within that limit.

Having thus fully explained my discovery of the expansive power and force of steam, I shall proceed to describe my improvements grounded thereon; and in so doing, I shall find it necessary to mention the entire steam engine and its parts to which as an invention well known I neither can nor do assert any exclusive claim; but at the same time I must here observe, that, from the nature of my said discovery and its application, there can be no difficulty in distinguishing my said improvements from the improved engine, as to its other common and well-known component parts.

First, if the engine be constructed originally with the intention of adopting my said improvements, it ought to have two steam vessels of different dimensions, according to the temperature or the expansive force determined to be communicated to the steam made use of in working the engine; for the smaller steam vessel, or cylinder, must be a measure for the larger. For example, if steam of forty pounds the square inch is fixed on, then the smaller steam vessel should be at least one fortieth part the contents of the larger one. Each steam vessel should be furnished with a piston, and the smaller cylinder should have a communication both at its top and bottom (top and bottom being here employed merely as relative terms,

Fig. 2.

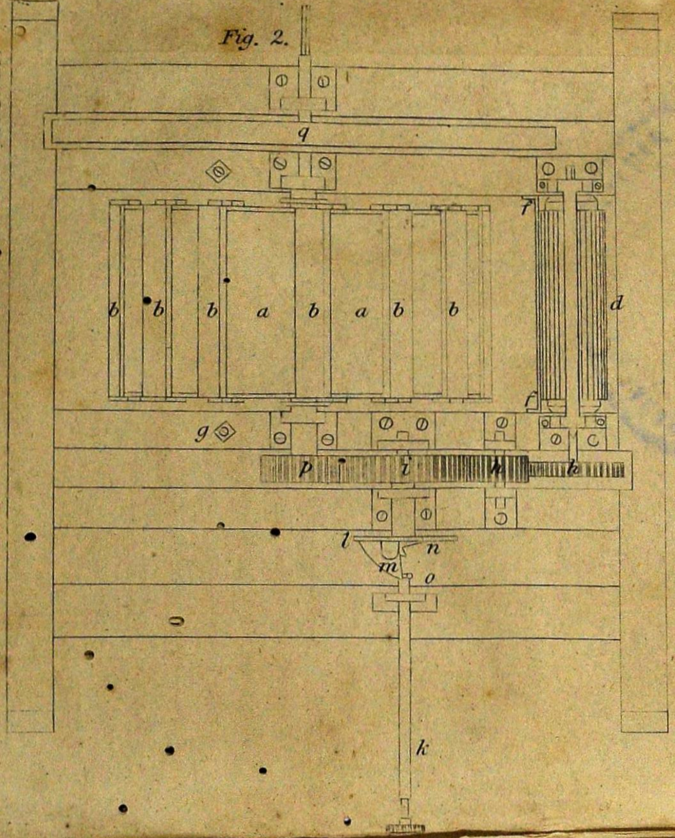


Fig. 1.

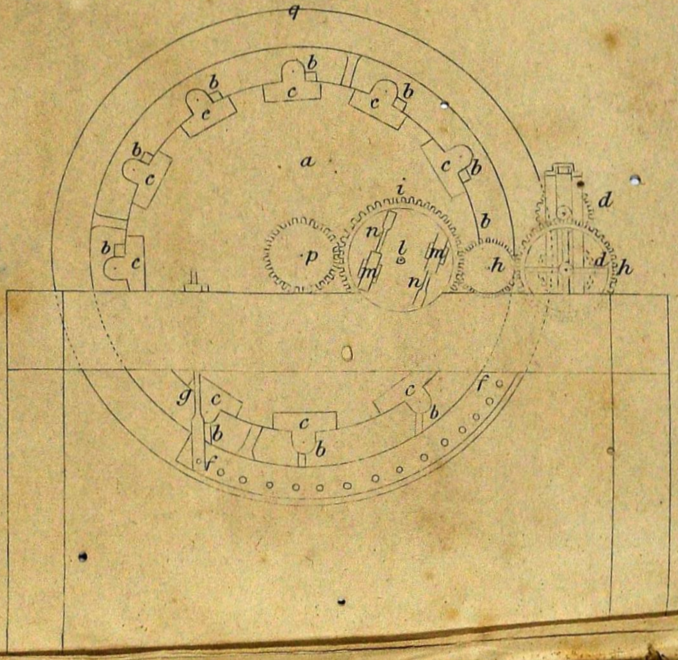
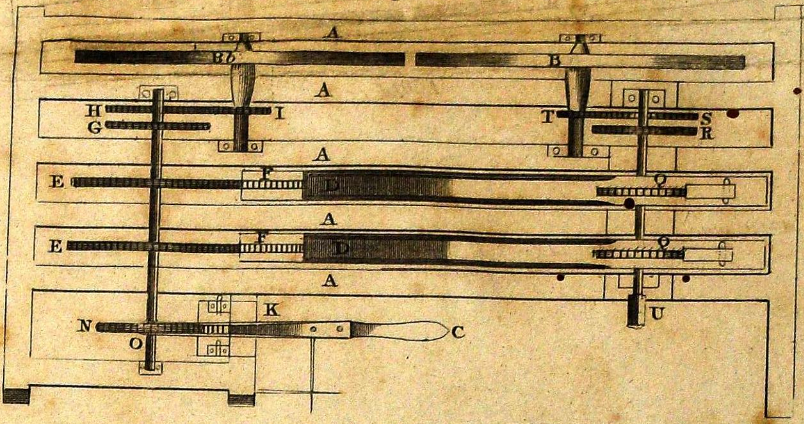


Fig. 1.



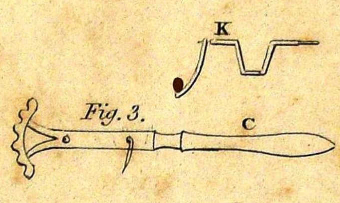
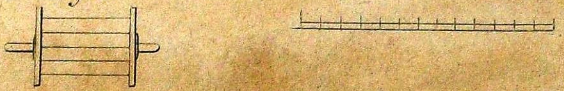


Fig. 3.

Fig. 5.



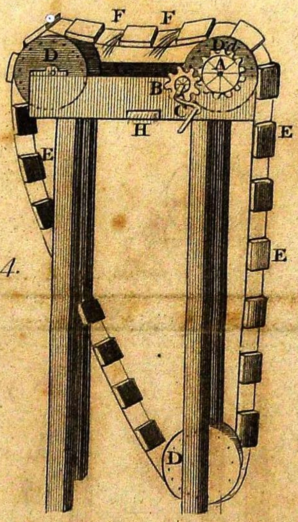


Fig. 4.

Fig. 2.

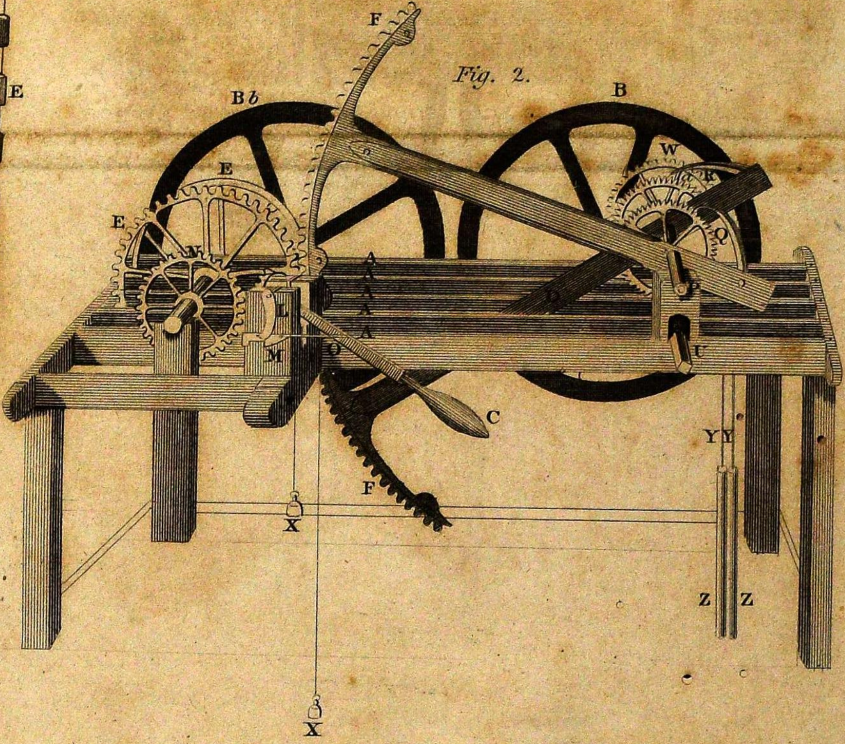


Fig. 7.

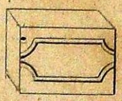


Fig. 6.

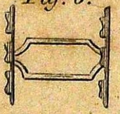


Fig. 2.

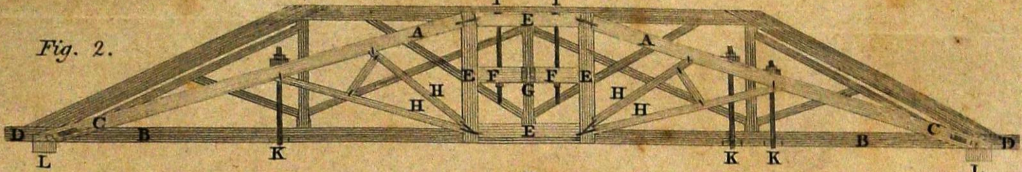


Fig. 3.

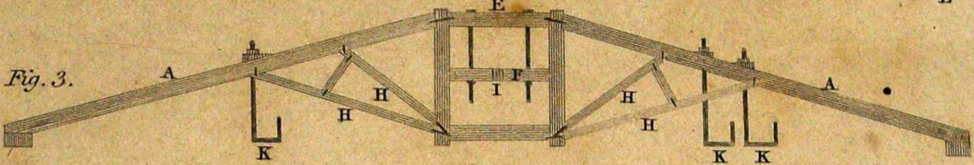
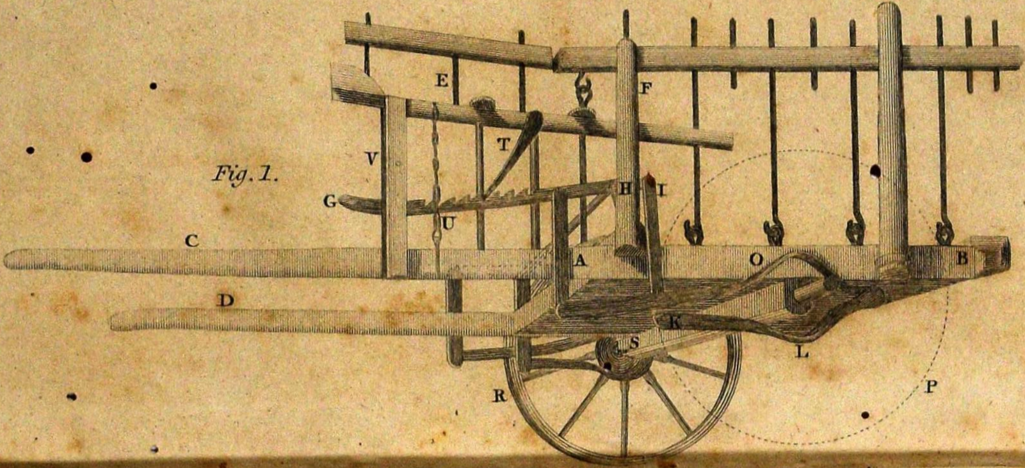


Fig. 1.



terms, for the cylinders may be worked in a horizontal, or any other required position as well as vertical).' The small cylinder, I say, should have a communication both at its top and bottom with the boiler which supplies the steam, which communications, by means of cocks or valves of any construction adapted to the use, are to be alternately opened and shut during the working of the engine. The top of the small cylinder should have a communication with the bottom of the larger cylinder, and the bottom of the smaller one with the top of the larger, with proper means to open and shut these alternately by cocks, valves, or any other well-known contrivance. And both the top and bottom of the larger cylinder or steam vessel should, while the engine is at work, communicate alternately with a condensing vessel, into which a jet of water is admitted to hasten the condensation; or the condensing vessel may be cooled by any other means calculated to produce that effect. Things being thus arranged, when the engine is at work, steam of high temperature is admitted from the boiler, to act by its elastic force on one side of the smaller piston, while the steam which had last moved it has a communication with the larger steam vessel or cylinder where it follows the larger piston now moving towards that end of its cylinder which is open to the condensing vessel. Let both pistons end their stroke at one time, and let us now suppose them both at the top of their respective cylinders, ready to descend; then the steam of forty pounds the square inch entering above the smaller piston will carry it downwards, while the steam below it, instead of being allowed to escape into the atmosphere, or applied to any other purpose, will pass into the larger cylinder above its piston, which will take its downward stroke at the same time that the piston of the smaller cylinder is doing the same thing; and while this goes on, the steam which last filled

filled the larger cylinder in the upward stroke of the engine will be passed into the condenser, to be condensed during the downward stroke. When the pistons in the smaller and larger cylinder have thus been made to descend to the bottom of their respective cylinders; then the steam from this boiler is to be shut off from the top, and admitted to the bottom of the smaller cylinder, and the communication between the bottom of the smaller and the top of the larger cylinder is also to be cut off, and the communication to be opened between the top of the smaller and the bottom of the larger cylinder, the steam, which in the downward stroke of the engine filled the larger cylinder, being now open to the condenser, and the communication between the bottom of the larger cylinder and the condenser shut off; and so alternately admitting the steam to the different sides of the smaller piston, while the steam last admitted into the smaller cylinder passes alternately to the different sides of the larger piston in the larger cylinder, the top and bottom of which are made to communicate alternately with the condenser. In an engine working with the improvements which have been just described, while the steam is admitted to one side of the piston in the smaller cylinder, the steam on the other side has room made for its admission into the larger cylinder on one side of its piston, by the condensation going on on the other side of the large piston which is open to the condenser; and that waste of fteam, which takes place in engines worked only by the expansive force of steam, from steam passing the piston, is prevented, for all steam that passes the piston in the smaller cylinder is received into the larger. In such an engine, where it may be more convenient for any particular purpose, the arrangement may be altered, and the top of the smaller made to communicate with the top of the larger, and the bottom of the smaller with the bottom of the larger cylin-

der;

der; in which case the only difference will be, that when the piston in the smaller cylinder descends, that in the larger will ascend, and while the latter descends the former will ascend; which for some particular purposes may be more convenient than the arrangement before described.

Secondly, as the difficulty of giving a proper degree of strength to large cylinders, and the cases for the same which are to be exposed to the action of strong steam, increases in proportion as their size is augmented, instead of employing, besides the smaller cylinder or steam measure, one cylinder only of large diameter in steam engines of great power, I sometimes prefer substituting for the latter cylinder two or more cylinders of smaller diameter, but of such dimensions that their capacity and the area of the pistons worked in them are equal to the area of the one piston, and the capacity of the one cylinder, which otherwise would be necessary; and such substituted cylinders are made to communicate with each other, that they may at one and the same time receive and part with the steam by which the engine is worked; and their respective piston rods are so connected with one another, or with other parts of the machinery, that the pistons may act together.

Thirdly, with regard to steam engines, which are already constructed, I improve the same by adding thereto a small cylinder or measure for the steam admitted to the working cylinder; this improvement may be introduced with great advantage into the steam engines, constructed according to Mr. Watt's improvements, which small cylinder may be either employed only as a measure of the steam, or a piston may be worked in it by the expansive force of the steam, before it be allowed to pass into the present working cylinder or steam vessel, which in that

case must have no direct communication with the boiler, but must be supplied with steam through the medium of the small added cylinder or steam measure. To make this more intelligible, suppose the steam measure or small cylinder added to one of Mr. Watt's single engines, or to one of similar construction, and that the small added cylinder is furnished with a piston, to work by the expansive force of the steam, while the larger cylinder works by condensation, then all that is necessary is, that the top of the smaller added cylinder be connected with the boiler, and furnished with a cock or valve to shut off the steam, and the boiler be of sufficient strength: let a pipe pass from the top to the bottom of the smaller added cylinder, furnished with a cock or valve, by which a communication may be made between the two sides of the piston in the said cylinder; let a pipe also pass from the bottom of the smaller cylinder to the top of the larger; let the larger cylinder, as is now commonly the case in practice, have a pipe passing from its top to its bottom, by which a communication can be made between the two sides of the piston in the large cylinder; and let the large cylinder communicate with a condensing vessel, with valves, cocks, or any other contrivance to open or shut the different communications when necessary; things being thus arranged, suppose the engine at work, and the pistons in both cylinders at the top of their respective cylinders, and suppose the steam admitted to enter the small cylinder above the piston; while the steam is thus entering, let the communication between the bottom of the small cylinder and the top of the large one be open, while the bottom of the large one is open to the condenser, then both pistons will descend. When they have reached the bottom of their respective cylinders, the communications between the

the boiler and the small cylinder, between the small cylinder and large cylinder, and between the latter and the condenser, must all be shut off; and the communications must be opened between the two sides of the smaller piston, and between the two sides of the larger piston; then as the pistons ascend, the steam which was last admitted above the small piston will pass to its under-side, while the steam which was last admitted to the top of the large from the lower part of the small cylinder will pass into the lower part of the large cylinder under its piston, and both pistons will at the same time ascend by the action of the counter-weight, or the momentum of the fly, as the case may be. When both pistons have reached the top of their respective cylinders, the last-mentioned communications are shut, and the others are opened as before, and both will descend; the steam which was last admitted to the under-side of the small piston passing into the upper end of the large cylinder, while the steam last introduced below the piston of the large cylinder goes off to the condenser; or an arrangement similar to the following may be adopted: let only the bottom part of the smaller cylinder have a communication with the boiler, and let there be also a communication between the bottom of the smaller and the top of the larger cylinder, and another communication between the top part of both cylinders, which last-mentioned communication always remains open; and let the top and bottom of the large cylinder also communicate by means of a side-pipe; and let the bottom part of the large cylinder communicate with a condenser. Things being thus arranged, when steam is admitting into the lower part of the smaller cylinder, the piston in that cylinder will ascend; the communication between the top of the two cylinders being then open, to allow the

the steam above the smaller piston to pass into the top of the larger, where it is not to be detained, but along with the steam above the piston in the large cylinder, to be allowed to pass under the last-mentioned piston (which is now ascending as well as the piston in the smaller cylinder), the communication between the two sides of the large piston being now open, and the communication with the condenser shut off. Both pistons having reached the top of their respective cylinders, the communications which before were open must now be shut (excepting the communication between the two cylinders at their upper part), and the communications between the bottom of the small and the top of the large, and between the bottom of the large and the condenser, must be opened; the steam last admitted into the lower part of the smaller cylinder will now ascend into the top of the larger and expand itself, following the piston of the larger cylinder which is now descending, its other side being open to the condenser, and (as the tops of the two cylinders communicate) steam will also pass into the top of the smaller cylinder above its piston, so that both pistons descend together to the bottom of their respective cylinders, when a fresh charge of steam is again to be admitted for a fresh stroke of the engine.

Fourthly. If my improvements be applied to one of the engines known by the name of Watt's Double Engine, the working cylinder must have no direct communication with the boiler; but must be made to communicate at its top and bottom alternately with the lower and upper part of the smaller added cylinder, or simply, as the case may be, at its top and bottom, with the steam measure, which has a direct communication with the boiler; the effect of which must be sufficiently obvious from the details I have already given respecting the

the nature of my invention, and the way in which the same is to be carried into actual practice.

Fifthly. With regard to steam engines, in which the separate steam measure may not be thought adviseable, the same may be improved by the appplication of my aforesaid discovery, by making the boiler, and the steam case or cases in which the working cylinder or cylinders is or are inclosed, much stronger than usual; and by altering the structure and dimensions of the cocks, valves, slides, or other means of admitting steam from the boiler into the cylinder or cylinders, in such a manner as that the steam may be admitted very gradually by a progressive enlargement of the aperture, so as at first to wiredraw, and afterwards admit more freely the same. The reason for this precaution is this: steam of such great elastic force as I employ, if admitted suddenly into the cylinder or cylinders, when more than one working cylinder is employed, would strike with a force that would endanger the safety and durability of the engine. The aperture allowed to the valve, cock, or other contrivance for admitting steam into the cylinder or cylinders, should be regulated by the following consideration. If the intention is that the engine should work only, or almost wholly, by condensation, the steam in passing into the cylinder or cylinders should be forced to wiredraw itself, as I have already said, but so that the piston or pistons may perform the whole or a great part of the stroke by the time the intended quantity of steam has been admitted into the cylinder or cylinders; for example, when steam of forty pounds the square inch is used, such a quantity of the same as shall be equal in volume to one fortieth of the capacity of the cylinder or cylinders, and so in proportion when steam of any other force is employed; and when the

the requisite quantity has been admitted, the steam is to be shut off till the proper moment for admitting a fresh quantity. But if it is intended that advantage shall also be taken of the elastic force of the steam acting on one side of the piston or pistons, while condensation goes on the other side, then the steam must be admitted more freely, but still with caution at the first, for the reason already mentioned. And in this as well as in every other application of my said improvements, grounded on my said discovery of the law of the expansibility of steam, due and effectual means must be used to keep up the requisite temperature of all the parts of the apparatus into which the steam is admitted, and in which it is not intended to be condensed. And here it may be proper to state, that, instead of the obvious and usual means for accomplishing this, namely, inclosing them in the boiler, or in a steam case or cases communicating with the boiler, the following method may sometimes be used with advantage, *viz.* a separate fire under the steam case or cases, which, in that event, will become a boiler or boilers, and must be furnished with a safety-valve or valves to regulate the temperature. By means of the last-mentioned arrangement, the steam from the smaller cylinder or steam measure (when either of these are employed) may be admitted into the larger cylinder or cylinders kept at a higher temperature than the smaller, by which its power to expand itself may be increased; and on the contrary, by keeping the larger at a lower temperature than the smaller, its expansibility will be lessened, which, on particular occasions, and for particular purposes, may be desirable. In every case care must be taken that the boiler, the case or cases in which the cylinder or cylinders is or are inclosed, the steam pipes, and generally all the parts

parts exposed to the action of the expansive force of the steam, be of a strength proportioned to the high pressure to which they are to be exposed. With regard to the due degrees of strength of the parts of all my said improvements, together with the nature of the materials, and the proportions of the same, except as herein described, I forbear any farther description, on account of the numerous variations to which the same must be subjected; and because every engineer, of sufficient skill to be employed in works of this nature, will, without difficulty, arrange and determine the same according to the nature of the case.

Lastly. I have to observe, that, to avoid unnecessary tautologies in speaking of the proportion that ought to subsist between the smaller cylinder or the steam-measure and the larger cylinder, or the quantity of steam to be admitted to the working cylinder, where a separate smaller cylinder or steam-measure is not adopted, though I have mentioned the regular proportions, as, for example, of a measure or quantity equal to one fortieth of the working cylinder when steam of forty pounds the square inch is to be employed, or equal to one thirtieth, or one twentieth, when steam of thirty or twenty pounds the square inch is to be used; yet these are not the only proportions that may be used, for, though it may not be adviseable that the proportion of the smaller cylinder or steam-measure should in any case be made much smaller than I have stated, yet, in making it larger, considerable latitude may be allowed; for example, with steam of forty pounds the square inch a smaller cylinder or measure of one twentieth, or even larger, or of some intermediate proportion, may be employed instead of one of a fortieth of the capacity of the larger or working cylinder; and so with steam of any other given strength.

strength. And it may be adviseable, that in a number of engines this should be the case, because of the difficulty of preventing some waste of steam or partial condensation which might lessen the rate of working, if not allowed for in the size of the smaller cylinder or steam-measure; or in the quantity of steam admitted directly from the boiler into the working cylinder, where no smaller cylinder or steam-measure is employed; and in every case the engine, when got ready for work, whatever may be the proportion that has been adopted as intended to be worked with, should have its power tried, by altering the load on the valve that ascertains the force of the steam, in order that the strength of steam best adapted for the engine may be ascertained; for it may turn out to be advantageous that the steam should be employed, in particular engines of an elastic force, somewhat over or under what was first intended.

In witness whereof, &c.

Specification of the Patent granted to Richard Bate, *of Little Hulton, near Bolton, in the County Palatine of Lancaster, Fustian Weaver; for a Machine to pump Water, and other useful Purposes.*

Dated November 26, 1791.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Richard Bate do hereby declare that my said invention of a machine to pump water, and other useful purposes, is described in the plan and description thereof hereunto annexed.

In witness whereof, &c.

Description

DESCRIPTION OF THE DRAWINGS.

Fig. 1, Plate VI. is an horizontal view of the engine or machine, part thereof being a frame of wood. A A A A A, five, ribs, placed two inches asunder, for the purpose of letting the different wheels of the said machine, and the two beam-levers D D, to work and pass in the distances, (in the said figure,) and also in Fig. 2. Fig. 3 is a new-constructed lever, with a segmental circle of brass or iron at one end thereof, containing a variable number of teeth, moving or working upon an iron crank, with an iron notch, returned catch and stop, fixed upon one end of the crank and the headstock in which the said crank is fixed; the notch and catch being to keep the teeth of the said segmental circle firm in the teeth of the lever-wheel N, in both Fig. 1 and 2, during every stroke or return of the lever, and the stop to lift up the catch at the end of every stroke or return to make or effect a new one, for the purpose of setting or putting, continuing, and keeping, the whole of the wheels and other works or movement contained and fixed in the said machine in motion. K, the iron crank. L, the returned catch. M, the notch to receive the catch, and O the stop to lift the notch M at the end of every stroke or return of the lever C. O, in Fig. 1, is an iron axle, which lieth horizontal to, and extends from, one side of the said frame to the other, in five separate steps of brass, fixed separately upon five wooden head stocks, for such axle to lie in, and move and turn round upon, (the two steps in each of the outsidemost head stocks covering each end of such axle, and keeping the same firm in the said five stops); which said axle passes through four iron wheels, fixed fast upon the squares of the said axle, which wheels are for the follow-

ing purpose; *viz.* the above-mentioned lever-wheel (whose diameter is five inches and one-tenth of an inch in the above-described drawing, marked N, Fig. 1,) receives and is worked by the teeth in the said segmental circle at the end of the aforesaid lever, which lever-wheel turns the axle, and the three other wheels thereupon fixed as aforesaid. The beam lever-wheels E E, in the same figure, (whose respective diameters are nine inches and five-tenths of an inch in the model,) being toothed half way round their respective circumferences, work the hereinafter mentioned and described beam levers F F in same figure. (The toothed-parts of these two last-mentioned wheels are reversed; that is to say, the teeth of the one wheel are uppermost when those of the other are underneath or below the centre of such other wheel, in order to work the said beam-levers alternately, the one rising whilst the other is falling.) And the other toothed-wheel G, in said Fig. 1, (whose diameter in the same model is also five inches and one-tenth part of an inch,) works and turns two other wheels, the one marked H in said Fig. 1, (whose diameter is also five inches and one-tenth part of an inch); but the other being a multiplying wheel, on one inch and nine-tenths of an inch in diameter in the aforesaid model, lying exactly underneath the wheel G, cannot be seen in said Fig. 1, which wheel H turns another multiplying wheel of the same diameter of the last-mentioned multiplying wheel, fixed upon the axle of the fly-wheel B *b*; which fly-wheel regulates the motion of all the said wheels N E E G H, and the multiplying wheel underneath the wheel H. D and D, in both Figs. 1 and 2, are beam-levers, of twenty-six inches and one-tenth of an inch each in length from the extreme ends to the sweep of the segmental circle thereon hereinafter described, and twenty inches from the respec-

tive

tive centre or axis of such beam-levers to such sweeps of the said segmental circle, and which sweeps are respectively fifteen inches and eight-tenths of an inch in length, fixed upon the axle P; the segmental head parts being of wood, with a segmental circle of brass screwed to each, containing thirty-four teeth in the said model, more or less, and which same teeth meet and respectively enter the teeth of the said beam-lever wheels E E above described. From each of which beam-heads hang suspended the weights marked X X, in order to increase their power in dropping after their respective teeth have parted from, or quitted those in the respective beam-lever wheels, whereby the power of the wheels upon the axles P and U are greatly increased. Upon which axle P are fixed two detent or saw-toothed wheels Q Q, which pass through a notch, nick, or opening, in the said extreme ends of each beam-lever, which being held, stopped, or detained, by two iron stays, causes the action of the axle U, in both the said Figs. 1 and 2, placed underneath the axle P and the two wheels thereupon fixed marked S, in Fig. 1, whose diameter is also five inches and one-tenth part of an inch in the aforesaid model; but the other being a multiplying wheel also, of one inch and nine-tenths of an inch in diameter in the aforesaid model, lying exactly underneath the wheel S, cannot be seen. Which two last-mentioned wheels turn the other fly-wheel B; which fly-wheel regulates the motion of all the said wheels, fixed upon the said two axles P and U; which axle U being made square at one end, and extending two inches in the said model, from or out of the said frame, enters into a square socket in the centre of the wheel A, Fig. 4, whose diameter is two inches and seven-tenths of an inch in the said model, and

and thereby works the bucket-pump, Fig. 4, hereinafter described.

Fig. 4, is a new-invented bucket-pump, for the purpose of raising large quantities of water, which may be afterwards turned upon a water-wheel. The wheel A, whose diameter in the said model is two inches and seven-tenths of an inch, being fast upon the same axle with the roller D *d*, the square socket fixed upon or in the centre thereof receives the square end of the axle U, in Figs. 1 and 2, D *d*. D and D are octagonal rollers, whose respective diameters are three inches and eight-tenths of an inch in the same model, turning upon their respective axis for the purpose of turning the cans or buckets of the same pump. (See Fig. 5.) E E and E, being three of the respective cans or buckets fixed to certain links of iron, as being described, Fig. 6, being a link, and Fig. 7, being a link and can, fixed together, which go round the aforesaid rollers D *d*, D and D, and are filled with water along with the rest of the cans or buckets, as described in Fig. 4, and are filled with water out of a trough or reservoir of water, to be placed at the foot or bottom of the same pump; and when they respectively arrive at F, empty themselves into the trough G; which water runs out of the same trough at H, in said Fig. 4, upon or into the buckets of a water-wheel.

N. B. The above machines and parts thereof may be made of different sizes and dimensions at pleasure.

Specification

Specification of the Patent granted to Robert Frith, *of Broughton, in the County of Lancaster, Dyer; for an improved Method of dyeing Cotton Wool, Cotton Twist, Cotton Weft, and Cotton Cloth, of a Nankeen Colour and of a Buff Colour.* Dated October 3, 1804.

To all to whom these presents shall come, &c. Now know ye, that in pursuance of, and in compliance with, the said recited proviso, I the said Robert Frith do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is as follows: My invention or discovery of an improved method of dyeing cotton wool, cotton twist, cotton weft, and cotton cloth, of a nankeen colour, and of a buff colour, consists in the use, either conjoined or successive, of an infusion or decoction of galls, mahogany bark, alder bark, oak bark, elm bark, schumach, and madder, or of any one, two, or more of them, and of a solution of iron; prepared by means of the sulphuric, nitric, muriatic, and acetous acids, or any one or more of them, or by any other acid or acids commonly used for such solutions, or prepared in any other way in which the solulution of iron, commonly called iron liquor, is prepared.

And I disclaim under this patent the use either of the above infusion or decoction solely, or of the above solution solely; and confine my invention or discovery, and right to the use of both, either jointly or successively, the same having never been before, either jointly or successively, used in the same process in dying buff or nankeen, and being substances which probably were not tried for that purpose, because they are the common ingredients used in making black ink.

I also disclaim any right to the invention of making or preparing the above infusion or decoction, and solution,

tion, or any of them, reserving nevertheless to myself such right as I have under a former patent *, dated May 25, 1798, to my invention of a then new chemical method of dying different permanent colours upon cotton, linen, woollen, and silk, for the term in such former patent mentioned.

As it is necessary in the use of my invention here specified to connect it with other processes in dyeing before known, I shall now state the manner in which I most commonly connect it with other processes, and which I believe to be the most advantageous mode of connecting or using it. After washing the substance to be dyed in hot water: first, I dip it into an infusion or decoction of galls, mahogany bark, alder bark, oak bark, elm-bark, schumach, and madder, or of any one, two, or more of them. Secondly, I pass it through a solution of iron, prepared as before mentioned. Thirdly, I wash it well in warm water. Fourthly, I pass it through a solution of soap in water, or through a solution of any of the alkalies, either mild or caustic, in water, or through lime-water. Fifthly, I dip it, while remaining wet, into a solution of tin prepared by means of either the nitric acid, or the muriatic acid, or the nitro-muriatic acid, diluted with water. After washing the substance so dyed in warm water, and drying it in the usual way, the operation is complete. The first and second operations may be performed in a different order; that is, the substance to be dyed may be first put into the solution of iron, and afterwards dipped into the before-mentioned infusion or decoction, or the infusion or decoction and solution of iron may be mixed together, and the substance to be dyed may be passed through the mixture; but I prefer

* Published in the thirteenth volume of the first series of this work, page 230.

the

the successive use of the infusion or decoction, and the solution of iron, in the order in which I have first mentioned them.

It may be proper to state, for the information of those persons who are not conversant with the art of dying, that in the above process an infusion or decoction of galls produces a yellowish-buff colour, and that the addition of a small quantity of mahogany bark or alder bark to the infusion or decoction of galls produces a proper buff colour; and that the addition of a greater quantity of mahogany bark or alder bark to the infusion or decoction of galls produces a nankeen colour, the proportions of each of which may be varied according to the shade of colour which the dyer wishes to produce.

In witness whereof, &c.

Method of preventing Accidents to Horses and Carriages in going down Hills, by a Gripe or Clasp acting on the Naves of the Wheels of the Carriage.

By Mr. WILLIAM BOWLER, *of Finsbury-street.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Ten Guineas were presented to Mr. BOWLER *for this Invention.*

BY means of this contrivance a cart may be stopped in an instant in going down the steepest hill with a load, without stopping the horses, by the carter only pressing his hand upon a lever. This plan would likewise be highly advantageous in case of a horse taking fright, as the carriage may be instantly stopped by the brace clasp-

ing the wheels. It may also, with little alteration, answer for a broad-wheel waggon with a heavy load. By the present method a coachman, whilst sitting on his box, may confine or release the wheels of his carriage at pleasure, and prevent accidents in descending hills, or in managing restive horses.

Reference to the Engraving, Fig. 1, Plate VII.

A B, the extent of the body of the cart.

C D, the two shafts.

E, the front ladder of the cart, part of which projects over the shafts, and is supported on them: the other part is fastened to the upright piece F.

G, the handle of the lever, sliding betwixt two uprights, and moveable on an iron bar and pivot at H, in the upright piece F. By pressing down this handle, the moveable joints I K raise upwards the lower part of another lever L, so as to press against the lower part of the nave of the wheel, and at the same time the moveable joints press down the lever O, and cause this lever to act against the upper part of the nave of the wheel; thus compressing the nave of the wheel betwixt a double brace, and either retarding wholly the motion of the wheel, or allowing it to move a little, as may be thought requisite. The circle of the nearer wheel is shewn by the dotted lines P; but this wheel is not added, as it would prevent this gripe from being clearly seen. The handle of the lever G produces at the same time a similar effect on the further wheel R, by means of the bar of iron which crosses the cart at H, and acts in the same manner on similar double joints at the other side of the cart, as may be seen at S, where the farther double gripe is shewn pressing on the nave of the farther wheel.

T,

T, a small catch, which, by falling into the notches or teeth of the lever, when it is pressed down, holds both the gripes in one certain position.

When the wheels are to be set at liberty, the catch T is removed out of the teeth of the lever; then the lever G is raised above the hole V, and kept from sliding down by an iron pin, attached to the chain U, being put underneath the lever, through the hole V.

The iron-work is not any inconvenience in the loading or unloading of the cart, nor occupies any room within it; and, what is of material consequence in new inventions, it may be managed by the carter with much less time and trouble than the common hook and drag chain. It is also much more secure in its action, as it binds on both wheels at once, and gives a uniform steady draught for the horses, which prevents them from falling down.

Method of raising a Roof sunk in the Middle.

Invented by Mr. James Woart, *of Fulham.*

With an Engraving.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Silver Medal and Twenty Guineas were voted by the Society to Mr. Woart *for this Invention.*

Fig. 2, Plate VII. shews the new and old truss combined.

A A, is the principal new truss. It is bolted into the old girder B B at C C, and also secured behind the said bolts, by firm corkings D D, four inches square, which may be made of hard wood or iron, and are let one half

into the new principal A, and the other half into the old girder B, in order to prevent a lateral pressure upon the walls. The bolts go through the new truss A and the old girder B.

E E E E, is a square oak frame; F F, the slider within it; which slider is rather thicker than the square frame, and notched into the old king post at G, through which part it is bolted with two iron bolts.

H H H H, are four braces, framed at one end into the principal, and at the other into the square frame E. There are butments at the ends of each, and they are secured by iron plates: they are farther strengthened by two cross pieces.

I I, two bolts, with screws, extending from the top of the square frame E through the slider F; which screws serve to raise up the king post and the centre work of the old truss and roof, by means of nuts, under the sliding piece F.

K K K, are three screws, hooked at the bottom, under the old girder B, which screws should be worked at the same time the slider is screwed up, in order to raise the sunk centre of the old girder to its proper height.

L L, the wall plates on which the girder lies.

Fig. 2, the new truss shewn separate.

A A, the principals.

D D, the corkings, shown by dotted lines, being on the other side of the principals; they should be made of iron, or very hard wood.

E, the square frame, made of oak.

F, the oaken sliding piece, which is moveable in a groove, in the sides of the frame.

H H H H, the four braces, shewing their butments.

I, the nuts and screws of the two bolts in the sliding piece.

K K K,

KKK, the other screws; the hooked parts of which are exhibited in a side view, to explain their construction, and how they act upon the girder.

Letters from the Rev. John Owen, of Fulham, Mr. George Smith, of Putney, and Hennege Legge, Esq. of Putney-house, noticed in high terms Mr. Woart's character and abilities. Mr. Smith stated, in his letter of the 12th of May, the particular circumstances which occurred during the present business. H. Legge, Esq. at whose house the improvement* made by Mr. Woart, as noticed in a former volume, was executed, certified, on the 11th of May, 1803, that Mr. Woart was entitled from him to a testimony of his superior skill, and that he was also the efficient person employed on the present occasion.

Of the Saltzburg Method of bleaching Cotton; and the Art of dyeing Cotton and Flax a solid Red.

By M. C. Schoerbring.

From Kong. Vetensk. Academ. nya Handlingar.

I. THE cotton-thread is always washed before it is given to be woven. The method of washing in question renders it whiter than the ordinary bleaching. It may be performed equally well upon the woven cotton. This method of washing the cotton, which is called, for what reason I know not, the Saltzburg method, notwithstanding that it is practised principally at Ratisbon, where four families have for a long time possessed it as a secret, which has not yet transpired; this method, I say, renders

* A method of securing beams or girders of timbers decayed by time, or injured by the dry-rot. See vol. II. of the present series of this work, page 346.

the

the cotton more pliable; the cloth which is made of it is of a closer and more even texture; the cotton does not require any farther bleaching, and when it is afterwards dyed, it takes a more beautiful, more solid, and more uniform colour. This washing is performed with soap-water and a strong ley, in the following manner.

The articles to be washed, which generally consist of cotton thread, stockings, caps, and handkerchiefs, are spread out in a large vat, and disposed in the following order. The bottom of the vat is covered with a piece of coarse linen, above which are placed, first the handkerchiefs, then the stockings and caps, and lastly the thread. The whole is then covered with another piece of coarse linen, of a close texture and very clean, in such a manner as entirely to prevent the contact of the air. A caldron, $1\frac{1}{2}$ Swedish ell in diameter above, and $1\frac{1}{4}$ below, and an ell deep, is filled with water, and a sufficient quantity of caustic ley is added to make it feel unctuous to the touch. To this water are then added 2lbs. of Ratisbon soap, in shavings. A fire is then made under the caldron, and when the ley boils it is poured upon the cotton; it is drawn off a little after, in order to heat it anew, and during this interval hot soap-water is continually poured upon the cotton. These operations are continued from four to six hours, or till it is certain that the cotton is well soaked and heated. It is then still steeped for twenty-four hours in soap-water. This operation is generally performed between midnight and six o'clock; the following morning the soap-water is drawn off, the cotton is well washed, and the water pressed out of it by means of a screw-press. This is the first washing.

When the cotton has been thus well steeped, they proceed to the principal washing in the following manner.

The

The steeped cotton is disposed in the vat as before, only with this difference, that it is surrounded with cotton instead of linen cloth, which resists less the action of the caustic ley. They must have prepared a clear and colourless ley with two-third parts of beech-ashes, and one-third part of lime. This ley is brought to that degree of concentration that an egg sinks slowly in it. The ley is boiled and poured upon the cotton; it is then drawn off, heated anew, and poured again upon the cotton. They continue to repeat this process from midnight till noon, or the space of twelve hours. The whole of the ley is then drawn off, the vat is removed, the cotton, while hot, is spread out, by means of the hands covered with gloves, upon a table, after which it is put again into the vat but in a reversed order. The same washing is repeated with cold ley, and continued for twenty-four hours.

The caldron is then filled with water, two pounds of soap put into it, and made to boil. The cotton is washed with this water, which is continually kept boiling for twenty hours, and it is left to steep for ten or eleven hours. After this, the water is drawn off, the cotton is taken out of the vat, and spread out upon a long wooden table, where they wash it with pure water, striking it with a beetle, after which it is washed in running water. Finally, the water is squeezed out by means of a press, and the cotton put to dry upon poles in the sun, or, during moist weather, in a proper chamber.

The leys of these washings cannot be employed a second time, as they have acquired the colour of blood. They are mixed together and employed for the common leying of linen. The soap-water is rejected.

The poles upon which the cotton is hung ought to be washed every time. It is preferable, when the weather permits,

permits, to expose each piece to the free access of the air, by suspending them upon lines. The articles must not be crowded too close together, lest the parts to which the air has not free access should become stained with brown stripes.

Raw linen-cloth and thread may receive, by the same method, a half bleaching, only the ley must be made of but half the strength, and the leying must not be continued for so great a length of time as with the cotton, for fear of weakening the texture of the thread.

II. Linen and cotton, as vegetable substances, have the defect of not taking colours with solidity. The cause resides in their resinous principle, which we must endeavour to remove from them. Alcohol would be a sure and easy solvent for this principle; but its price is too high to admit of its being used for that purpose. After alcohol, the best solvents of this principle are oils of all kinds, but especially fish-oil. The cotton is steeped for twenty-four hours in this oil, after boiling it anew for the space of two hours; it is wrung out; it is suspended for some days in the air, in order that the oil may detach itself well from it; it is entirely freed from oil by the aid of a strong hot ley, and it is washed and dried. We may likewise employ for this purpose a ley of two-thirds of ashes and one-third of lime, and as much sheep's dung as both the ashes and lime taken together. The cotton is not only boiled in this ley, but it is leyed several times, and washed every time with pure water. We may likewise wash the cotton thread in water into which a quantity of potash has been put sufficient to render it unctuous to the feel. The thread is let boil in it for twelve hours, or till the ley becomes black. Then the thread is washed, and steeped in water acidulated with sulphuric acid (at most two drachms of acid to a pot of water). After steeping

a full

a full hour, it is taken out, washed, and put to dry. If the Saltzburg method of bleaching were once generally known, we should no more be obliged to buy cotton thus bleached, or to send cotton to Ratisbon to be bleached. In order to ascertain whether cotton bleached in any manner is perfectly freed from resin and fit to receive the colour, a glass is filled with water, and upon the edge of it a thread of cotton is placed, with one of its ends plunged into the water, whilst the other remains on the outside of the glass; if the end which is plunged into the water does not float at the top of it, and if the other sucks up the liquid and immediately lets some of it run down, it is a proof that the cotton has the requisite purity.

The cotton being thus purified, it must pass through three mordants; *viz.* 1. a decoction of galls, 2. a solution of tin, and 3, alum-water.

1. *Decoction of galls.* For one pound of cotton or linen thread. For the first take half a pound of black galls, and for the second a pound. Pound the galls coarsely, and boil them, together with a handful of birch-leaves, in a caldron of water with 2½ pots of rain-water, till it is reduced to one half. Let the decoction subside, and pour the liquid, whilst still hot, through a cloth, upon the cotton; let the cotton steep in it for twenty-four hours, turning it frequently, in order that it may be uniformly penetrated with the galling principle. Then take it out, wring it, and put it to dry, suspended in a free air, or in a warm chamber. Care must only be taken that no water may fall upon the cotton, which would occasion spots in the dyeing. In this operation, the thread ought to be strongly pressed together in order that the galls may penetrate it in an uniform manner. After this it is transported into a solution of tin, made

as shall be specified, and the decoction of galls is put by, to be used in the aluming.

2. *The solution of tin* is made in the following manner. Sal ammoniac or sea-salt in fine powder are dissolved to saturation in one pound of aqua fortis. We then add two ounces of fine English tin, in shavings, or as much as the acid liquor can hold in solution. We also dissolve two ounces of sea-salt in a pint of rain-water, and pour, drop by drop, under continual stirring, the solution of tin into this saline water. We then put the galled thread into a dish of earthen ware, press it well, and pour the mixture upon it. Sometimes the thread is turned with the hand, in order to favour the penetration. The thread is covered to guard it against the access of the air, and it is left to soak for twenty-four hours. It is then taken out, wrung and put to dry in the air, or in a warm chamber, where it is left for forty-eight hours. After this it is washed with pure water, dried again, and transported into alum-water made as we are about to direct.

The remaining solution of tin is kept for a next operation. It is then sufficient to take, for one pound of thread, three-fourths of a pound of aqua fortis, and the other ingredients in proportion.

3. *Alum-water.* The alum, of whatever kind it may be, must be previously calcined for this use. A pound of crude alum is taken for a pound of thread. After it is calcined, it is pulverized and dissolved in a pint of water; to it is added a little more that a pint of the residuous decoction of galls; they are mixed well, the mixture is heated and poured upon the thread that has passed through the solution of tin. The thread is left for fourteen hours in this bath, after which it is expressed and put to dry.

Dyeing.

Dyeing. Into a caldron of proper dimensions is put one pound of good madder, pounded or ground, which has been steeped for some hours in water; the caldron is filled with water, and placed over a moderate fire. As soon as the matter begins to be heated, the thread is put into it and continually turned. It is necessary that the thread should have been previously steeped in water, and afterwards wrung, in order that the colour may penetrate in a perfectly equal manner. The thread is left in the bath till the liquor boils. It is then taken out, well washed, the threads are arranged upon the hand, and the water is pressed out. This first dyeing gives the thread a pale red colour. The caldron is then emptied; it is filled with water, madder previously steeped in water is put into it, and heat is applied. As soon as the bath is hot, the thread is put into it, and let boil in it for a quarter of an hour. Care must be taken not to apply too strong a fire. The first bath must but just boil, for fear the thread might acquire a brown colour; but this inconvenience is not to be dreaded with the second bath, when the thread is already penetrated with the red colour. After the thread has been well washed for the second time, it must have a deep brown colour; if it has not this colour, it must be boiled anew, with a quarter of a pound of madder. After the last dyeing, the thread is washed with the hand in hot soap-water after having been washed in cold water, and it is put to dry.

Inquiries respecting the tinning of Copper, Pewter, and Pottery. By *M.* PROUST.

(Continued from Page 48.)

PART II.

On the old Tinning.

DOCTOR Malouin, when he proposed the tinning with zinc, censured that which was in use, only in order to warn us, after the example of many others, against the dangers to which we were exposed by it. But how far do these dangers go? what can result from the use of a tinning more or less charged with lead? This is what no person, since that academician, has examined, or even undertaken to examine.

Kemerlin, the author of the alloys examined by Hellot and Geoffroy, Doucet, Chartier, La Folie, Buschaendorf, and a great number of others, who have been alternately the echoes of the terrors and alarms with which Europe has so long been annoyed, have likewise made no experiments to discover in how far it concerned us to mistrust these tinnings.

But chemistry, which incessantly calls our attention to the great difference which exists between metals and their oxydes, considered relatively to their salubrity, teaches us constantly that these terrors might, from different motives, be exaggerated; and that the sentence of proscription, so justly pronounced against the pernicious oxydes, ought not to be extended with such rigour to the metals which serve for their base, as that we should conceive ourselves in continual danger of our lives, because they may sometimes be used in our kitchens. Chemistry therefore, equally remote from suffering herself to be intimidated

timidated by the common panic, and from the disposition to wish to calm our apprehensions by inspiring a security which might be attended with fatal consequences, has shewn at all times that it would be safer to abandon the uncertain principles which have served as the rule under these circumstances, and more useful to investigate with respect to each metal, what we have really to apprehend from each of them, considered as metals and afterwards as oxydes, rather than to attend to vague opinions, dictated more frequently by interested views than by a real concern for the public good.

In this state of the case, wishing to subject the question concerning the tinnings to the light of chemical analysis, which at the present day is so much more rigorous in its means than in the times of Malouin, of Geoffroy, of Macquer, &c. I imagined that the most certain means of elucidating it, as its importance requires, would be to underdertake different very simple experiments, which age after age has neglected to execute notwithstanding that reason loudly demanded them. In order to place myself in the true point of view indicated by prudence, that is to say, at a certain distance from every passion, it was necessary that I should address myself to impartial readers, and for this purpose abandon many scientific terms, in order to enable them to judge for themselves of the consequences which result from these experiments. I shall begin with a general review of the metals and their oxydes; I shall confine myself, however, to those which are the most employed in the arts, and which nevertheless may be sufficient to establish the principles which we ought to have in view in order to decide impartially upon the question of tinning.

1. Of

1. *Of Iron.*

Iron is a metal which is oxydated with such facility in a moist atmosphere or medium *, that there is no perceptible difference, with respect to its medicinal effect, between the internal use of iron and oxydated iron.

2. *Of Antimony.*

The oxyde of antimony at the inferior degree †, if taken in a dose exceeding some grains, might excite vomiting, convulsions of the stomach, inflammation of the intestines, and even death. For the passage of this metal through the intestinal canal commonly produces only that irritation which medicine desires, in order to obtain salutary evacuations; that is to say, an effect proportionate to the small quantity of oxyde which appears to be formed round the metal during the time that it remains in the body.

3. *Of Mercury.*

Mercury, in large doses, as it has frequently been prescribed in the disease called the Iliac Passion, has produced no other effects than salivation; whereas its oxydes at the *maximum* and at the *minimum*, taken in very small doses, would occasion very troublesome affections, of which death might sometimes be the consequence.

* Metals are oxydated more or less easily in the air, because oxygene is one of its component principles, as it is of water, acids, and an infinite number of natural bodies.

† It is known that most metals may unite with oxygene in two different, but always invariable, proportions. Oxyde at the inferior degree, is the term applied to that which contains the oxygene in the smallest proportion: twenty-two parts of oxygene combined with 100 of metal form the oxyde of antimony at the inferior degree, and thirty of oxygene the oxyde at the superior degree.

4. *Of*

4. *Of Arsenic.*

Arsenic, considered as metal, is very nearly as hurtful as its oxyde, on account of the facility with which moisture causes it to pass into the latter state; but it has been found that, when it is preserved from that change by means of its union, with sulphur, tin, lead, &c. its effects are no more so formidable. Bayen caused different animals to take arsenic combined with tin, in quantities sufficient to have deprived them of life if they had swallowed it pure, and yet none of these animals appeared to be incommoded by it. The interesting work of Dr. Renaud upon poisoning with arsenic shews of what great importance it is that metals be not judged of in the same manner as their oxydes.

5. *Of Silver.*

Silver is a metal which may be introduced into the human body without doing it any injury; but the purest oxyde of this metal impresses such a remarkable caustic taste upon the tongue, that there can be no doubt it may prove a very active poison.

6. *Of Tin.*

Tin is administered in very large doses, and without the slightest danger, against the *tænia* *, and in maladies of the liver and uterus; but the effects of its oxyde, taken internally, are not known. I do not pretend to decide in a matter on which we as yet have no experiments; but I am inclined to believe that this oxyde would not produce dangerous effects, 1, because the miners and braziers,

* The French Encyclopedia gives, from the Edinburgh Transactions, the formula of a remedy against the *tænia*, or tape-worm, in which pulverized tin is an ingredient.

who

who so frequently respire air impregnated with this oxyde occasioned by the fusion, do not experience the colics with which persons who work in lead are affected; 2, because it is demonstrated that the very small quantity of tin, which the alimentary acids extract from tinned pots, has never, as we shall see hereafter, attracted the attention of physicians by the slightest inconvenience resulting from it. *Modò purum illud nec adulteratum sit*, as Schulz says in his dissertation, intituled, *Mors in ollâ*. But we shall soon see that the apprehensions of this learned physician, which at present are better appreciated, were destitute of foundation.

7. *Of Copper.*

Every one knows that copper, taken in substance, may produce fatal consequences, on account of the oxydation to which it is liable in the stomach and intestines. However, the accidents are rarely so serious as might be apprehended, for we daily see children swallow copper coins and discharge them, without this imprudence ever costing any their lives. But how much greater would not the danger be if they swallowed the oxyde of this metal, even were it below the tenth part of the weight of the smallest coin?

Copper is dissolved with much greater difficulty than is commonly imagined by the vegetable acids, even when aided by ebullition. It is impossible to dissolve filings of it in vinegar, although nothing is more prompt than its oxydation, when the air and the vapour of this acid in fermentation concur simultaneously to produce this effect. But how should the vegetable acids have this power? aqueous sulphuric acid is deprived of it. Accordingly, it is a truth universally acknowledged, that the boiling of sugar, of syrups, and of acid confectionary, of

of the juices of plants, of the must of beer or of grapes, has never occasioned bad accidents that have been well ascertained; for it is a precaution constantly observed in the houses where these preparations and several others are made, not to let them cool or remain for a long time, after being boiled, in the copper vessels, and this with the greater reason, as the precaution is of the greatest consequence to the dealers in such provisions. If they be suffered to remain for a certain time in the vessels, they contract an extremely disagreeable taste, and a colour which would soon bring them into discredit with the consumer.

I anticipate the objection which may be made to me. Can the magistrates, it will be said, rely as to what concerns the danger of copper upon the attention and honesty of a workman whose stupid indolence is not always roused at the view of his own danger? Undoubtedly not. But we ought no more to confound the apathy of these organized machines, whose only merit consists in the strength of their arms, with the vigilant and patriotic solicitude of a father of a family, who well knows that his reputation, and the prosperity of his commerce, are inseparably connected with the purity and good quality of the provisions which are prepared under his superintendance. And a proof that we are as much indebted to the religious solicitude of the man of integrity as to the vigilance of the legislator, for the security which we enjoy in this respect, is, that we very rarely see poison issue from the houses destined for the preparation of medicines, confectionary, and aliments. Let us incessantly call to mind the dangers to which carelessness and indolence in these arts may expose the lives of our fellow-citizens. Let the legislator and the physician denounce with the voice of eloquence and persuasion against the dangers

dangers with which we are surrounded; but let us at the same time guard against subjecting the workshops to coercive measures, which, if they are impracticable, become illusory expedients.

In fact, in pharmacy, in confectioners' and other shops, the great copper vessels are exposed, from very powerful reasons, to lose their tinning soon, without its being possible to prevent it, although in kitchens this accident may be obviated.

All those operations of cooking, which cannot be terminated without a degree of heat superior to that of boiling water, fuse the greatest part of the tinning, and reduce it into grains like shot, as the tin, which is not combined with the copper, falls to the bottom of the boilers, a moderate degree of heat being sufficient to liquefy it.

The continual friction which inevitably takes place during the preparation of pastes, extracts, and confectionary, which are strongly agitated with wooden spatules, tends also very speedily to destroy the tinning. We cannot therefore oblige the manufacturers or workmen employed in this labour to cover the copper with a preservative which would be of no duration, and which would be very expensive if it should be renewed as often as it was destroyed. In all the arts there are certain practices which the laws can never prescribe; but the philosophic legislator brings it about that they receive their sanction from the probity of the man himself who carries them into execution.

Even those who, for some time past, professed a doctrine entirely opposite to these truths, have confirmed them when they thought least of it; so difficult is it for a person to avoid falling into contradictions when he speaks contrary to his own conviction. On one of the

arts

arts in which vigilance against the dangers of copper is of the most essential consequence, a law has been imposed, to be always provided with three copper utensils, tinned according to the new method, namely, an alembic, a basin, and a capsule. But where is the laboratory, however small, in a capital, where we do not find twenty utensils of this kind, of all capacities? There is not a day that the workmen are not obliged to make fifty pounds or more of syrup, and sometimes of three or four different qualities. Could they make them in one of the three pieces tinned according to the regulation? These pieces will be kept by them in order to satisfy the vigilance of the magistracy, if it be required, rather than to fulfil the intention of the law, and they will always endeavour to have them of the smallest size. There are alembics of a capacity of 8, 10, and 20 *arrobes*, for making arquebusade, orange-flower water, peppermint water, &c. Will they perform these distillations in the small alembics tinned according to the new method? What is a single tinned basin for the use of a whole shop? Thus all these regulations will prove to be illusory, and fall very short of the purposes intended to be answered by them.

8. *Of Lead.*

All that has just been said of copper applies equally to lead. If the oxyde of this metal comes to mix with the aliments, or with the ambient air which the plumbers and colour-grinders are obliged to respire, it occasions those terrible colics and other disorders which Dr. Luzuriaga has so learnedly described. But lead in the mass, bullets and shot, which we introduce so frequently into our stomachs in eating game, do not expose us to very imminent dangers. This metal is not at all to be feared except in the alimentary canal; for we daily see soldiers

 who

who have bullets inclosed in their muscles, and who thus pass their lives without experiencing any inconvenience from them; which is owing to the circumstance that lead is oxydated but very slowly, even in humid mediums or bodies.

9. *Of Zinc.*

Respecting zinc, taken in substance, we have only ill-ascertained facts, which consequently obliges us, on this subject, to embrace the doubtful side. Patrin asserts, as has already been observed, that zinc is prescribed in Germany as an emetic and purgative. On the other hand, La Folie tells us that he has made different animals take it, without its having caused them any accident. I am much disposed to judge of zinc as La Folie does.

This philosopher, his friends at Rouen, the Abbé Rozier, author of the "Journal de Physique," Dr. Laplanche, at the request of the faculty of medicine at Paris, and several other persons, have tasted aliments prepared in pots tinned with zinc, without having experienced any inconvenience from them. With respect to the oxydated zinc, though the flowers and the sulphate of zinc are regarded as emetics, there is reason to believe that it ought to be considered in the same light as those of iron, tin, &c. on account of the force with which it retains the oxygene. Sage relates that the flowers of zinc, which raised themselves in the form of thick clouds from the fusion of bronze, did not occasion any inconvenience to the workmen in the foundery of Douay. But if, on the one hand, this oxyde is innocent in the internal use which is made of it, we shall not venture to say as much of its combination with vinegar, or of the acetate of zinc. I do not know whether we might with safety take doses of any considerable magnitude of this metallic salt, mixed with our aliments.

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The review which I have just given appears to me sufficient to afford the notions which we require, in order to enable us now to judge of what we wish to know respecting the ordinary tinning. And what have we to fear with respect to the lead which is an ingredient to the tinning? Is it the lead itself as metal? is it its oxyde, or else its dissolutions? It is from experiment that we must expect the solution of these problems.

PART III.

Experiments upon Tinning.

I caused five plates of copper, each a square foot, to be tinned, in order to know with accuracy the whole detail of this operation, which consists, as is known, in scraping the metal, in order to remove from it the particles of oxyde, which would impede the adhesion of the tin to the copper.

I shall class them here in the order of the losses which they underwent in the scraping.

The first lost - - - - - - - -	288 grains.
The second lost - - - - - - -	350
The third lost - - - - - - -	355
The fourth lost - - - - - - -	360
The fifth lost - - - - - - - -	393

We see from these results that the quantity of metal lost in the scraping is very variable; and that it is in the power of an evil-disposed workman to cause the pieces which are intrusted to him to undergo a great loss, without the owner's being able to perceive it, or even to complain of it; for the workman claims the right of being his own judge with respect to an operation which he asserts to be necessary for the application of the tinning.

This

This loss may not exceed two grains, as we see by the number 288, the double of 144, which represents the square foot; but commonly it is two grains and a half; for, at an average, the number 144 is contained two and a half times in that which expresses the loss.

It was now necessary to ascertain the quantity of tin which regularly attaches itself to the copper in the operation of tinning.

My five plates and a pot, scraped and weighed accurately, came from the operation with the following augmentations, which I shall specify here in arithmetical order, so that the differences may be more easily remarked.

A pot, having a surface of 144 inches, had acquired - - - - - - - - - - - - -	140 grains.
The first plate, of an equal surface,	144
The second - - - - - - - -	178
The third - - - - - - - - -	200
The fourth - - - - - - - -	208
The fifth - - - - - - - - -	230

We see by this account that the tin applies itself to the copper in a very variable manner; but the attraction of the copper for the tin being equal in all the points of the superficies, this difference of weight depends upon the more or less powerful pressure which the workman employs in order to remove the excess of tin; whence it results, that the workman has it in his option to tin one piece in a richer manner than another. We ought not, however, in this second operation, to judge in the same manner as in the first, for he may, for his own interest's sake, press the tinning as much as he will, without doing any injury to his work; since it is evident that the portion of tin, which adheres only to the tin itself, melts,

and

and falls to the bottom of the fat at the first impression of heat, whilst that which adheres to the copper (and it is in this that the tinning consists) cannot be fused by so low a degree of heat.

We see also, that a good tinning, which is not uselessly overcharged, consumes only a grain of tin *per* square inch; that the medium quantity is commonly a grain and a half; and that, finally, in order to preserve our utensils from verdegris, we are obliged to sacrifice two pounds and a half of copper for the purpose of applying to them one pound and a half of tin.

The tin for which the brazier demands to be paid is not merely that which he applies to the copper, but also that which he loses in the furnace and in the operation of the rubbers which he employs for the tinning. The scrapings of copper which he collects cannot be considered as an equivalent for the tin which he employs, because, not being pure copper, he cannot sell them for more than fourteen or fifteen quartos * the pound, a price always very inferior to that of copper, and even of tin. This difference proceeds from the circumstance that these scrapings form a compound of copper, brass, tin, and lead, and the founders consequently can employ them only for augmenting the mass of those large pieces of cast metal which do not require to have the brilliancy of copper or of brass.

On the Duration and the Causes of Destruction of Tinning.

The tinning with pure tin has a silvery white colour; and if some vapour impairs its brilliancy, it becomes a little yellowish.

The tinning with a third, a quarter, or a half part of lead, in short the old tinning, has a more brilliant aspect,

* About eight-pence.

pect, its colour approaches to that of glass containing mercury*. This tinning is very different from the former, and the workman distinguishes at first sight the tinning which contains lead. Let us now examine the causes which destroy the tinning, and the risks to which our health is exposed by the tinnings which contain, according to the custom of braziers, a third part of lead.

The causes of this destruction are of two kinds.

The first is the erosion to which the tinning is exposed from the friction with metal or wooden spoons, which the cooks use for stirring the matters which are prepared in boiling fat, &c. but still much more from the daily scouring with sand.

The second depends upon the solution which the tin may experience from the acids of vinegar, of lemons, of currants, &c. Let us return to the first cause.

There are detached from a too thick tinning, during the first days of use, some small drops of metal, which fall by their own gravity to the bottom of the aliments, and which rarely, or at least in very small quantity, are transferred from the pot into the dish, because it is equally rare that the cook does not perceive them. If this metal, which is in the form of small shot, comes upon the table, it likewise rarely happens that it is swallowed, because the tongue discovers and rejects it; and thus very little of it ever comes into the stomach. But, finally, whether it be swallowed or not, we have sufficient information to appreciate the danger which might result from it. No one has yet complained of these small metallic grains any more than of the leaden shot which are found in the pieces of the game which we eat.

A pot freed from all the superfluities of its tinning, which is not generally done with all, has no more particles which could mix with the aliments, excepting those which

which the iron spoons might detach from it, when farinaceous matters, herbs, &c. are fried in it. And even these particles are in such small quantity and so insignificant, that their existence may really be doubted. But admitting that they exist, it must however be agreed that, being distributed in a mass of aliments that is to be consumed by five persons at least, not the tenth part of a grain will be introduced into the stomach of each.

Suppose now that the tinning has been made with one half lead, which is the poorest tinning, the lead which will then come to the share of each person will be the twentieth part of a grain. What can we now have to fear from the twentieth part of a grain of lead, when we are in the habit of swallowing, in leaden shot, forty, nay a hundred times that quantity, without finding ourselves incommoded by it.

Arsenic, alloyed in the porportion of a fifteenth with tin, ceases to be a poison, as Bayen has proved. What then, I repeat, can we have to fear from a few particles of lead alloyed with tin?

The tinning of a pan that has a surface of a foot is not destroyed by the friction with the spoons in more than half of its surface, for the area of the bottom, compared with that of the lateral parts, is nearly in this proportion. In a house where the cook has any regard for the health of the family, they do not wait till the whole of the bottom of the pan is become bare, before they have it new tinned. The tinning of this utensil is always made with a third part of lead, because a larger proportion would too much impair that brilliancy to which the cook is accustomed in this article. The brazier therefore, who wishes to keep his custom, will deviate as little as possible from this proportion.

The tinning of this utensil, which is employed daily, lasts at least a month and a half, according to the calculation made by braziers and cooks.

The tinning with tin and lead does not leave more than a grain to the inch of copper, because the alloy being more fluid than if it were merely tin, it is wiped cleaner off with the scrubber.

If the bottom of this pan has lost all its tinning in forty-five days, it has lost about seventy-two grains of its weight, of which a third is lead, that is to say twenty-four grains. If we now divide these twenty-four grains by forty-five days, we shall find that there has been detached from it $\frac{24}{45}$ of a grain per day, or half a grain of lead alloyed with tin; and finally, dividing this half grain between five persons, each will receive only a tenth of a grain. But in order that this shall take place, we must also suppose that the daily scowering has not detached from the bottom of the pan a considerable part of its seventy-two grains of tinning; which is contrary to all probability. It must therefore be admitted, *that if the tinned copper pans caused fatal accidents, these accidents are owing more to the copper than to the tinning of the utensil, which the poor have not always the means of having tinned as often as they might wish.*

It results from all that has been said, that the lead which the aliments cause to detach itself, even from the worst tinning, amounts to so very small a matter, compared with the shot which is so frequently found in the game that we eat every day, that it would be alarming ourselves without any reason, to fear the accidents that might result from it; whence I conclude that the terrors, which are endeavoured to be excited under this first point of view, are at least without foundation.

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We shall now proceed to examine the tinning with regard to its solubility, and ascertain by actual experiment in how far we have reason to apprehend the results of this solution.

Of Tinning, considered as an Alloy soluble in the Acids which enter into the Composition of the Aliments.

I caused eight pots, of the capacity of about twenty ounces each, to be tinned; the tinnings being prepared in the following order.

1. Of pure tin;
2. Of tin with five *per cent.* of lead;
3. ——— with ten *per cent.*
4. ——— with fifteen *per cent.*
5. ——— with twenty *per cent.*
6. ——— with twenty-five *per cent.*
7. ——— with thirty *per cent.*
8. ——— with fifty *per cent,*
9. Of pure lead.

These eight tinned pots were placed upon the same furnaces with a pound of red vinegar, which was boiled in them till the quantity was reduced to one-half.

The vinegar of each pot was then poured into a mattrass, where it was kept for forty-eight hours, in order to leave the molecules which rendered it turbid time to be deposited. Each sediment was separated, washed several times with clear water, and afterwards kept moist in the same vessel.

The acetous liquid which belonged to these eight sediments was diluted with a quantity of pure water equal to the loss which it had undergone by the boiling, and each liquid was afterwards divided in two mattrasses.

From this operation resulted three classes, of eight mattrasses each, which contained,

The first and the second, the vinegar diluted with pure water, and divided in two bell-glasses;

The third, the washed and moist sediment which belonged to each pound of vinegar.

I afterwards threw into each mattrass of the first class about four ounces of solution of sulphate of potash.

Into each mattrass of the second class I put about four ounces of hydro-sulphurated water.

And into each mattrass of the third class, an equal quantity of the same water.

Let us now see the results of these mixtures.

When a liquor, such as wine, vinegar, &c. contains lead in solution, the sulphate of potash precipitates it in the form of a white powder, of which 136 parts constantly correspond to 100 parts of metal.

When a liquor contains lead, copper, and tin, the hydro-sulphurated water manifests the presence of each of these mixtures by the different colours, and separates them with the greatest accuracy.

When a sediment contains one or other of these three metal, its colour becomes extremely dark.

The first class did not produce any white powder; it therefore did not contain lead.

The second gave a light clear brown sediment, which indicated the presence of tin.

The sediments of the third class did not change their colour, whence I inferred that they did not contain any metallic part.

From what has been said it must be inferred, that vinegar boiled in tin pots, tinned with alloys more or less charged with lead, does not dissolve any of the latter metal, but only a very small quantity of tin. It is this that announced itself in the precipitates of a light brown colour, which we saw in the mattrasses of the second class.

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The sediments of these eight experiments contain therefore nothing of a metallic kind: it was of importance to be assured of this, because the tartar and the selenite, which formed the greatest part of them, would very well have been able to precipitate and carry with them the lead which the vinegar might have dissolved.

These experiments were repeated in the same pots, with very strong white vinegar, such as is used in the Royal Laboratory, and in that of the general hospital.

The vinegar was boiled in each pot, and it was evaporated till it was reduced to a fourth; after it had been taken out of each pot, diluted with pure water, and treated as in the preceding experiment, it was subjected to the same examination, and the results which were obtained with it perfectly confirmed the first. But these last experiments presented a peculiarity which did not appear in the first, because the vinegar was not equally strong. It consists in the circumstance that the tinning of the pots appeared after these last experiments of so leaden a colour, that it excited my curiosity, and induced me to press it with my fingers, in order to see if any thing would be detached from it. I found, in fact, that a grey powder was separated, which I collected with all possible care. This powder was nothing else than lead divided into molecules, so impalpable that it could not precipitate itself entirely in the space of twenty-four hours. I judged, from the mere appearance, that these sediments were the more voluminous according as they approached nearer to the tinning No. 8, which was the most charged with lead; however, the most remarkable of these sediments did not contain quite the weight of half a grain of it.

After having well distinguished this powder, I had still occasion to make a curious observation. I remarked that the

the leaden colour of the tinnings was lighter after the action of the vinegar, in proportion as they approached nearer to the No. of pure tinning; so that with a little practice, and having before our eyes pieces of comparison, we might easily indicate the degree of alloy of a tinning.

But the most interesting circumstance is the figures formed by the vinegar upon the fine tinning: they present concentric zones, interlaced in one another, of the diameter of a *peseta* *, touching each other at their circumferences, the lights and shades of which form so striking a contrast, that, whilst they delight the eye, they may at the same time serve to indicate the tinning which is made with pure tin. As I obtained the same figures in another pot tinned with pure tin, in which I had boiled vinegar, I conclude that we may, by means of this solution, ascertain whether any tinning is fine or not.

On reflecting upon results so unforeseen as those which I have just recorded, and which prove so clearly that lead, which is ordinarily so soluble in vinegar, is not at all so when it is alloyed with tin, I shall now say, that theory ought to have led me to foresee or discover them. It is an incontestible fact in chemistry, that tin is infinitely more disposed than lead to become oxydated and dissolved. It is equally well known, that if tin enters into a solution of lead it gradually precipitates the latter, by depriving it of the oxygene which served as intermediary to its solution, and restoring it by this means to the state of metal.

Such is the origin of the black powder of which I have spoken. The vinegar, in the first moments of its application, may very well dissolve some atoms of lead, but

* This is a coin of about the diameter of a shilling.

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the tin takes away from them the solvent with much rapidity, and precipitates them to the bottom, without their being able to enter anew into solution.

But it will be said, if the lead can by solution, and the precipitation consequent upon it, separate itself from the tinning, who can assure us that this powder will not come to mix itself with our aliments, and occasion colics?

To this objection I shall answer, 1st. that in the catalogue of dishes invented to flatter our taste, there is none which is prepared with a pound of the strongest vinegar, boiled and evaporated till it is reduced to a fourth, in a pot tinned with equal parts of tin and lead; 2, that if fashion should introduce the use of such a sauce, it would be very improbable that the cook should consider it an improvement to press the metallic particles with his fingers, in order to incorporate them with it. Thus we may be very easy with respect to our aliments, as long as such a mess is not introduced, and the cooks do not think of such an experiment.

I must still mention an anomalous circumstance, which I have not yet had time to examine.

In the first experiments which I made with the vinegar, No. 8, tinned with an equal part of lead, communicated something to the vinegar; but as this phenomenon did not occur again in any of the subsequent experiments which I made with the pots, I conceive that this isolated result ought not to invalidate the inferences with which I am about to conclude this article, and the more so as they are confirmed in all their parts by the soundest chemical doctrine.

It results then, from all these experiments, that the solution of the lead of the tinnings is a circumstance which we have little reason to fear in our kitchens. It will soon appear,

appear, that in order that this metal should dissolve in the vegetable acids, it would be requisite that the kitchen utensils should be of pure lead, or tinned with this metal alone. It has already been seen that the last means was impossible; and it is not to be presumed that the first is ever employed in our domestic establishments.

The glazing of ill-baked pottery is assuredly much to be dreaded, but tinning surcharged with lead is not so; or it must be proved to be the case by facts subversive of the best established truths of modern chemistry.

The law which enjoins the mixture of lead with tin for tinning is a wise one, like all those which emanate from so enlightened an administration. The pewterer's art ought not to be confounded with that of the brazier. Lead, by its nature, is not adapted to secure us against the dangers of copper, and tin, which the arts have chosen for this purpose, may be employed without alloy. However there are articles which depend upon the brazier's art, to which it would be, if not impossible, at least very difficult to apply the tinning without the aid of four or five parts in the hundred of lead. Such are the chocolate-pots and brass utensils which cannot be tinned so well with pure tin; such are the moulds which are used by pastry-cooks and confectioners; such are the articles which present many entering angles, alembics with narrow necks, coffee-pots, and other small utensils, which, besides that they are not in such general use as sauce-pans, are not exposed to lose their tinning, and still less to occasion any danger to the health of those who use them.

Tin runs better with the aid of lead, and it is applied more easily to all the interior part of utensils where the eye cannot direct the hand of the workman.

Kettles

Kettles for boiling water, the bottoms of which are destroyed more speedily than the rest, coffee and chocolate pots will undoubtedly be sooner spoilt, if the bottom is not strengthened by a thicker layer of tin. This precaution, which greatly prolongs the duration, exempts the poor from the necessity of having these utensils often renewed. But new pots or kettles ought not to be sold with this additional tinning, for the buyer would then pay for, as copper, what is not such. Every one may, after having purchased these articles, have them strengthened after his own manner, especially when they are tinned and marked according to the law. No one can then oppose a custom generally established, as there will be no reason to find fault with it. These additional tinnings ought to be made with three parts of tin and one of lead.

On Pewter.

I thought it would be useful, under the existing circumstances, to examine pewter with regard to its solubility in the vegetable acids which are employed in our kitchens.

I had several vessels cast under my own inspection in the following order:

No. 1,	pure tin.		
2,	95	lead	5
3,	90		10
4,	85		15
5,	80		20
6,	75		25
7,	70		30
8,	50		50
9,		Pure lead.	

 These

These nine vessels were filled with boiling vinegar and kept for three days. The vinegar of the eight first vessels was tried by means of the sulphate of potash; it did not present the slightest portion of dissolved lead. The ninth was surcharged with the latter metal; but hydrosulphurated water discovered to me the tin which was dissolved in the eight first liquids.

I repeated these experiments three times with vinegar of different strength, and I obtained the same result. The tin, which is always more soluble and more easy to be oxydated then the lead, easily suffers itself to be attacked by the vinegar; but the lead not at all, and this for reasons which I have explained in speaking of tinning. It is also for this reason that the vessels, after the vinegar has been kept in them, appear of a leaden colour. This surface, denuded of tin, appears to abound more with lead than the piece does in its thickness, but the slighest friction detaches the light stratum which is formed at the surface, and restores the vessels to its original state.

The celebrated Bayen found that a plate of pure tin, which had been used every day for two years, had not lost more than four grains of its weight. Tin alloyed with lead is harder than pure tin, and consequently less subject to mix particles of its substance with our aliments. What ought we, or what can we, then apprehend from this pewter? is it perhaps the particles of metal which might be detached from it by the motion of the knife and fork? This is a groundless terror. With regard to its solubility in the alimentary acids, we know very well that the most innocent of metals constantly protects us against the dangerous properties of the other.

Vauquelin, at the suggestion of the committee of weights and measures in France, who wished to know

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to what extent lead might be mixed with tin, undertook an enquiry similar to mine, which he has published in the thirty-second volume of the *Annales de Chimie*, p. 243. It will there be seen, that with the exception of some particular facts, which proceed undoubtedly from the difference of the vinegars of each country, his results are entirely conformable to mine.

Accordingly, I shall apply to the pewters the inferences which I have deduced from my inquiries upon tinning, and shall assert, that, if the fears which some have endeavoured to excite with respect to the use of pewter are entirely destitute of foundation, the necessity of introducing innovations in the pewterer's art is not substantiated; and that even if this art were capable of being improved with regard to what concerns health, we ought never to seek for this improvement in alloys which all Europe has not thought fit to adopt; for there would still be a number of other alloys which might be tried before having recourse to a metal so soluble and so unmanageable as zinc is in the operation of tinning.

Let us now cast a glance upon the alloys which are in use among the pewterers, in order to ascertain their relations with that which we have just analyzed. Pure tin is that which constitutes the first quality, and it is that which is employed for making vessels to hold ices, sherbet, &c. in use in the houses of the opulent and those who will have every article of the best kind.

The second quality serves for making jugs and plates, of every kind, in houses where a great quantity of metal ware, and such as will last for a long time, is required. It is composed of an ounce or an ounce and a half of lead to the pound of tin, which amounts to 8 or $8\frac{1}{2}$ per cent. of lead. If the fine tin costs 16 reals

the pound when wrought, this latter, which is almost fine, sells commonly for 14 or 15 reals.

The third quality, which is called the *regulation standard*, is composed of three ounces of lead to the pound of tin, which amounts to 15 or 16 per cent. This tinning in employed for sherbet-vessels, caraffes, saucers, and other utensils used in serving up lemonade. Its price is about 12 reals.

The fourth quality, or the common tinning, is composed of four ounces of lead and sixteen ounces of tin, which makes twenty per cent of the first metal; it is employed for making scrutoires, sand-boxes, spoons, candlesticks, surgical utensils and various small articles used for domestic purposes. The price of this tinning is less than that of the other, but it is regulated more by the workmanship than by the weight of the article.

We see from this sketch, that the poorest tinning, such as that of 20 per cent, is never employed in the fabrication of the utensils which serve for preparing and preserving our aliments and drinks. But, finally, even though a dishonest pewterer should employ it, his alloy can never be injurious to health, since vinegar may be kept in vessels alloyed with 33 or 50 per cent of lead, without its being possible to detect a sensible quantity of this metal in it. Before porcellain was in use, the luxury of our forefathers consisted in possessing an immense quantity of pewter. It has never been asserted that this metal, more or less alloyed, has been prejudicial to their health, or shortened their days. The history of medicine does not present any authentic fact to prove that the alloy of tin and lead merits the sentence of proscription pronounced against lead and copper.

TO BE CONTINUED IN OUR NEXT.

Experiments

Experiments and Reflections on the Apparent Repulsions between some Fluids; observed by M. DRAPARNAUD; *and detailed in a Memoir inserted in our preceding Volume. By* DR. JOACHIM CARRADORI DE PRATO.

From the ANNALES DE CHIMIE.

THE observations, which Citizen Draparnaud relates in the *Annales de Chimie* * of Paris, are not new; and the consequences which he deduces from them are false. Several years ago † I observed that some fluids are driven by others upon the surface of water; and I have proved that these repulsions are only apparent, and that they proceed solely from the different degrees of attraction, which these fluids have for the surface of the water. Several times, in different journals ‡, and particularly in my replies to Prevost §, and in some letters written to Professor Brugnatelli ||, I have insisted upon the true explanation of phenomena of this kind, proving by decisive experiments that these motions, which are believed to be the effect of a repulsion, proceed all from the same principle, namely, *the attraction of surface;* from whence it results that one fluid being attracted more than another, the other must necessarily retire from the surface on

* Memoire sur les movemens que certains fluides recoivent par le contact d'autres fluides, an. II. No. 141. See vol. V. of the present series of this work, page 146.

† Giorn. Fisic. Medic. di Pavia, 1793, Ann. Chim. di Pavia; Opuscoli scelti di Milans.

‡ Giorn. Italiani, et Journal de Physique de Paris; Ann. de Chim. de Paris.

§ Ann. Chim. di Pavia, tom. XIX. Ann. de Chim. de Paris, No. 143. an. 12.

|| Ann. di Chim. di Pavia.

which

which it was extended, and obeying its own cohesion or force of aggregation become concentrated.

I have lately resumed this subject, and have presented it in its clearest point of view, in a memoir inserted in the eleventh volume of the Transactions of the Italian Society of Sciences, where I have demonstrated, in the strictest manner, that the attraction of surface is the cause of the pretended repulsions of some fluids upon the surface of fluids, and of some fluids upon the surface of solids.

Professor Brugnatelli, in extending my experiments on the attraction of surface, had already spoken of the repulsions recently observed by Citizen Draparnaud; for he had remarked that several fluids thrown by drops upon the polished surface of solids, repelled each other; namely, oil, spirit of wine, oil of turpentine, and ether *.

Citizen Draparnaud says now, that alcohol or spirit of wine drives water and other liquids from the bottom of the vessels, because there is a continual emission of subtle particles, which, forming an atmosphere, produce the repulsion of the water, as Prevost has said of odorous atmospheres; and according to him, all volatile bodies are capable of doing the same at the ordinary temperature of the atmosphere, for he is of opinion that they act mechanically, that is to say, by means of the impulsion of their emanations.

But let me be permitted to oppose to him some facts, and some reasoning, in order to elucidate the truth. Water indeed retires from the surface of the vessel to which spirit of wine is applied; but it is not true that it is driven by a repelling force. It is equally erroneous, that the space left by the water, in making this experiment, is perfectly dry, as Draparnaud says; but there succeeds in the place of the water a slight stra-

* Ann. di Chim. di Pavia, tom. XVIII.

tum of spirit of wine, which soon evaporates. The water, as well as the other fluids brought together by Draparnaud, retire, because they are obliged to yield the surface to the spirit of wine, which has more attraction for it than they, and seizes it with more energy: thus left to themselves, they become concentrated. In fact, a drop or two of spirit of wine, poured at a moderate temperature upon a plate, for example one of porcellain, is seen to extend itself upon and cover the surface like a varnish; but this does not happen when a drop or two of water is poured upon it, because it has not so much attraction of surface. The integrant particles of the water, which have a greater affinity of aggregation or cohesion with each other than attraction for the surface of the supposed body, do not extend or dilate themselves in that manner.

It is so true that spirit of wine or alcohol attaches itself more strongly than water to the surface of vessels, that if we throw a drop or two of this fluid upon a porcellain plate, and after it has extended itself upon it, forming a kind of disk, pour some drops of water upon it and force them to take the place occupied by the spirit of wine, we shall see the water, unable to detach the spirit of wine, obliged to pass over it, and the alcohol remain always fixed upon the surface of the plate.

But I can produce an easy experiment, which is in direct opposition to the opinion of Draparnaud. I fixed in the middle of a porcellain plate a small ball of soft wax, and I formed a cavity in it with the head of a large pin; I then poured into this plate a quantity of water, sufficient to rise above the margin of this cavity, without penetrating into it. The vessel being thus prepared, I dipped a straw-tube into spirit of wine, and conveyed a drop of this fluid into the cavity of the ball, so as to fill it.

it. Thus I brought it about, that a drop of spirit of wine remained surrounded with water and almost in contact with it, and remained also below the level of the water. It is certain that, if spirit of wine were capable of exercising an expansive force by means of its emanating particles, it ought to have produced it in this case; but I did not observe any motion of repulsion in the water which surrounded the drop of spirit of wine. The water remained still tranquil and immoveable, as if it had been close to any not volatile fluid.

But when the water had passed the margin of the small cavity in the wax, it rushed into it to find its level; and I observed the small bodies which floated upon the surface of the water remove themselves from the above-mentioned cavity while the water flowed into it. This proves, that spirit of wine has, like the other volatile fluids, the property of spreading itself upon the surface of water, before it mixes with it.

In fact, I have observed that spirit of wine, when applied to the surface of water contained in a cup in which a drop of oil is extended, drives it away, taking its place, and obliges it to concentrate itself. If likewise we apply a little cotton dipped in spirit of wine, or a drop of this fluid, to the surface of water upon which some small pieces of gold or silver leaf are floating, we see them remove themselves and fly off. These small bodies also sometimes remove themselves and fly off at the approach of a small bit of cotton dipped in spirit of wine to the surface of the water upon which they lie; but they do it feebly, and not with that celerity as when we approach to them a little cotton dipped in ether *, and this because the spirit of wine, both in the state of fluid

* See my replies to Prevost, in which it is seen that ether is a fluid which approaches more than spirit of wine to the nature of the oils.

and

and in that of vapour, as it applies itself to the surface of the water, has the property of spreading itself upon it, like the oily substances.

But if we previously apply to the surface of the water a drop of the milky juice of tithymal, then throw upon it small pieces of silver and gold leaf, and touch it as usual with a little cotton dipped in spirit of wine, or even pour a drop or two of this fluid upon it, we shall not see the small pieces of leaf that float upon it do as before, because the spirit of wine traverses the surface of water occupied by a fluid which has a greater attraction for it. The case is the same if we apply to the surface of the water any fluid, the most volatile and the most oily, when it has previously been occupied by the juice of tithymal; none has the power of driving it away; but this juice, as soon as it touches the surface of the water*, drives from it all the most volatile and the most odoriferous oils, and obliges them to concentrate themselves at the extremities of the vessel in the form of small spheres.

I ask, from what cause, if these repulsions are occasioned by the impetuous efflux of odoriferous particles, has the milky juice of tithymal, which is neither volatile nor odorous, the power of driving from the surface of water the most volatile and most odoriferous fluids?

However, if we gently place a drop of spirit of wine in the middle of a plate, and then moisten the plate with water in such a manner, that it approaches to a distance of only two lines from the drop, we shall see it, before it dilates itself, exercising a repulsion upon the water which surrounds it, especially if it approaches too near; and, in my opinion, this effect is owing to the vapours of

* Memoir on the attraction of surface, in Transact. of the Italian Society of Sciences, vol. XI.

the

the spirit of wine, which act at a distance, not because the water is repelled by a mechanical motion, but because, when they strike the surface of the plate, they extend themselves over it, and expel the water from the surface.

If it then happens that the drop of spirit of wine begins to touch the water which surrounds it, we immediately see an agitation produced, by which the water is repelled with much vivacity, and the drop of spirit of wine, animated with a new expansive force, breaks its limits, extends itself, and causes the water to recede. Nearly the same is the case with a small piece of camphor. If we put a small piece of this substance upon a pretty large plate, covered with water to the height of a line, in such a manner that the piece of camphor can touch the bottom of the plate, we shall see the water in a kind of *contrast* around the camphor, and it will seem that an expansive force keeps the water at a distance. All this, in my opinion, is the effect of the attraction of surface of the spirit of wine, and of the oil of camphor with the water. In fact, the oil of camphor, solicited by the attraction of surface of the water, evaporates with astonishing celerity, and is consumed in a short time. The same is the case with the spirit of wine and the oil of camphor; they precipitate themselves upon the water, extend themselves upon its surface with surprizing speed, whence proceeds the dispersion of the water, and the adhesion of the spirit of wine to the bottom of the vessel. The accelerated evaporation of these fluids can be attributed to no other cause than to this force, namely, the attraction of surface, by which the cohesion of the integrant parts is overcome, and consequently the expansive force of the small volatile parts which compose those fluids augmented; but

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I have elsewhere sufficiently explained these phenomena relative to the motions of camphor upon water *.

A drop of volatile alkali or ammoniac, says Draparnaud, does not drive the water from the bottom of the vessels like spirit of wine, because the ammoniac has much affinity with water. But cannot we say as much of spirit of wine? However, this repulsion ought to take place, when water surrounds a drop of ammoniac as near to it as possible, but without touching it, and yet this does not happen.

A drop of ammoniac in the middle of a stratum of spirit of wine does not repel it, nor produce the circle of recession; but a drop of spirit of wine in the middle of a layer of ammoniac repels it around, and forms the circle. This shews, according to Draparnaud, that the expansive force of the spirit of wine is greater than that of the ammoniac.

But I have remarked that ammoniac has no attraction of surface, or at least very little, with the bottom of the vessels, whilst on the contrary alcohol has a great deal. Let a drop of ammoniac be poured upon a plate of porcellain or on a piece of crystal, and also a drop of spirit of wine; the first remains concentrated, and the other dilates itself; thus we see why the spirit of wine repels the ammoniac upon the bottom of the vessels, and why the ammoniac does not repel the spirit of wine.

Besides, if the expulsion of the ammoniac depended upon the mechanical impression of the emanations of the spirit of wine, it could scarcely manifest itself, for the force of the emanations of the spirit of wine must be

* Medico-physical Journal of Pavia; Annals of Chemistry of Pavia; Select Treatises of Milan; and latterly in some letters written to Professor Brugnatelli; Annals of Chemistry of Pavia; and the Memoir on the attraction of surface, vol. XI. of the Italian Society.

 weak-

weakened by the force of the emanations of the ammoniac; and yet it manifests itself with the same promptitude as that of the water. It is also observed that some fluids almost equally volatile and odorous, applied one after the other to the same surface, repel each other. For example, the essential oil of turpentine repels naphtha, and ether repels the essential oil of turpentine. How could this happen if the opposite forces destroyed each other? But it happens thus, because the essential oil of turpentine has more attraction of surface than the naphtha, and the ether more than the essential oil of turpentine.

But there is an observation of Draparnaud's which deserves to be discussed. He has remarked, that ammoniac expels oil from the surface of vessels, though it expels neither water nor spirit of wine. I have, moreover, remarked that the mere approach of a drop of ammoniac to the surface of the oil produces in it an evident commotion, like blowing. It appears, therefore, that the emanations of ammoniac render themselves in this manner apparent to the eye, that is to say, by means of the expulsive power or the mechanical impulse exercised upon the oil.

I do not pretend, nor have I ever pretended, that there may not be emanations of volatile bodies capable of rendering themselves perceptible to the sight in this sense, but only to shew that several phenomena, which pass for effects of repulsion caused by the expansion of the volatile bodies, do not depend upon this cause, but that they are effects of attraction of surface, and that there are no means of rendering perceptible to the eye, as Benôit Prevost imagines, the emanations of the odoriferous bodies. But before we decide upon the effect of ammoniac upon oil.

oil, we must pay some attention to these remarkable observations.

If we throw small pieces of silver or gold leaf upon the surface of oil contained in a goblet, and then approach a drop of ammoniac, we shall observe a commotion in the surface of the oil, and in the small pieces of metal which float upon it; if we apply the drop of ammoniac to the surface of the oil, the small bodies will recede still more, and we shall see this fluid diffuse itself upon the surface in the most visible manner, whilst it produces an agitation in it.

If we perform this operation upon water, that is to say, if, after having thrown upon the surface of water, contained in a similar vessel, very light bodies, as for example small pieces of metal leaf or raspings of cork, we approach or apply to it a drop of ammoniac, no motion will take place. The same will be the case if, in place of water, we use spirit of wine, or any other not-oily fluid; but, if in place of these floating bodies, there is a drop or two of oil upon the water, this will experience a commotion from it. If we approach the drop of ammoniac perpendicularly to the oil floating upon the water, it causes it to dilate when the whole of the oil is in the form of a drop; and, when it is spread out in the form of a pellicle, it divides and scatters it. If we squeeze a piece of orange peel over the surface of water, and afterwards approach to it a drop of ammoniac, we shall remark, at all the oily points with which the surface of the water is sprinkled, that a slight agitation takes place.

It seems therefore, according to these experiments, that ammoniac renders the emanations upon oil sensible to the sight, not by a mechanical impulsion, but by a

physical

physical action, since it does not manifest itself upon the other fluids.

It cannot be doubted, that the impulse or the expansive force of the ammoniacal emanations ought to act indiscriminately upon all bodies, and communicate to all the same impulsion, when they can move freely, and a drop of ammoniac approached to the surface of spirit of wine, because it is equally light, if not lighter than oil. I have moreover found that ammoniac, when approached to the smoke of a candle that is turned by the slightest breath, does not produce any motion in it: thus the effect of ammoniac upon oil cannot be attributed to a meçhanical action.

But here is a proof which admits of no reply. If we throw raspings of cork upon water, and then approach a drop of ammoniac to them, no motion is produced. But if we take another quantity of cork-raspings, and having rubbed them between the fingers smeared with oil, throw them upon the surface of water in another glass, and again approach a drop of ammoniac to them, then all these small bodies will move in a surprizing manner. If we throw wheat-flour into another glass of water, the approach of the drop of ammoniac will not cause these small molecules to move, but if we throw into it the flour of almonds, which is oily, it will cause them to move, and to be precipitated to the bottom of the vessel. The same experiment, repeated in a thousand different ways, will always confirm my conclusion, namely, that the action of ammoniac renders itself sensible upon the oils, and upon all matters that are oily or impregnated with oil.

I think, therefore, that I have demonstrated, that the repulsion which ammoniac exerts upon oil, is not an ef-

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fect of the force of its emanations or vapours, and I believe that it ought to be attributed to the attraction of surface which ammoniac has, both in, the fluid state and in that of vapour, with the oil itself, conjointly with a chemical attraction, which results from the changes which oil undergoes when it is exposed to the effluvia of ammoniac. This phenomenon is to be explained, in my opinion, in the same manner as that of a drop of water exposed in the middle of a stratum of water; that is to say, that the repulsive power which the ammoniac seems to exert upon the oil, proceeds from the expansion of the ammoniac, or of its vapours upon the oil, by means of the attraction of surface.

In fact, if we throw a drop of ammoniac upon the bottom of a vessel, and pour around it a very little oil, in such a manner that it surrounds the drop of ammoniac, spread out the oil with the finger, and approach ammoniac to it, we shall see the oil recede; but when it comes to touch it, we then see the drop of ammoniac break its limits, extend itself over the oil, and disperse it with astonishing celerity.

The ancients would have attributed it to an antipathy between the ammoniac and the oil; but these chimerical notions have vanished before the light of experimental philosophy. It does not appear that the repulsions between the different fluids can now be supported, after the laws of attraction of surface which I have observed *.

* See my memoir on the attraction of surface at the place cited.

Extract

Extract of a Memoir of M. Payssé, *principal Apothecary to the Camp at Utrecht, on the Preparation of some of the Oxydes of Mercury in the large Way.*

By M. Parmentier.

From the Annales de Chimie.

I HAVE formerly announced the details which I am about to present to the reader on the processes which the Dutch employ in the large way for preparing the red sulphurated oxyde of mercury and the red oxyde of mercury by the nitric acid. M. Payssé, to whom we are under this new obligation, does not lose an instant in availing himself of the advantages afforded him by his residence in Holland; he seizes every opportunity of visiting the manufactures which are so numerous in this country, as well as the cabinets of the curious which may serve for his instruction. The disgusts, the difficulties of all kinds which he has experienced in procuring admission into the work-shops, serve to demonstrate the ardour of his zeal for the sciences and the arts; but in the midst of the obstacles and inconveniences which meet the traveller in the way of his researches, he frequently obtains a compensation for the labours which he undergoes and the sacrifices which he makes, when he is so fortunate as to meet with some objects adapted to gratify his desire of adding to his knowledge, and enriching his country with the discoveries of the industrious nations whom he has occasion to visit. Such is the enviable lot of M. Payssé, who has already procured detached information upon a variety of interesting subjects; and how valuable that information is will be easily judged from the extract which I am about to give from the last memoir which this chemist has transmitted to me.

Red

Red sulphurated Oxyde of Mercury.

This substance is prepared only in the manufactories at Amsterdam, the most considerable of which is that which belonged to the late M. Brand. M. Payssé was present at an operation in which about 400 kilogrammes (800 lbs.), divided in two apparatus, were prepared. He followed the details with all the attention in his power; and, after having compared them with those which M. Tukert has published in the fourth volume of the "Annales de Chimie," year 1790, p. 25, he found only very slight differences in them, so that the description of the Amsterdam author must be considered as very nearly accurate. The circumstances which he omitted are as follows. He has not spoken of the duration, or of the colour of the flame which proceeds from the combustion of the combination of the sulphur and mercury which is prepared beforehand and introduced into the apparatus. This flame, the disengagement of which is extremely rapid, presents the most varied colours, at first of a vivid dazzling white, elevating itself at least twelve decimeters above the dome of the furnace, afterwards yellow and white, orange yellow, blue and yellow, giving rise then to green, violet, and at length blue and green tinges; its disengagement is regulated towards the end by a kind of register of iron-plate; when it elevates itself no longer more than some centimetres, and its colour is of a fine azure or indigo blue, the apparatus is hermetically sealed and luted externally with a mixture of clay and sand.

It cannot be doubted, considering the loss which is sustained in the result of this operation, that the so multiplied tinges of this flame, the disengagement of which lasts about half an hour with 200 kilogrammes of matter, are owing to the union of the sulphur with varied proportions of mercury at different degrees of oxygena-

 tion.

tion. The 400 kilogrammes, or about 800 pounds of red sulphurated oxyde of mercury, are found reduced to 379 or 322 kilogrammes, or from 738 to 745 pounds, which makes a loss of from 27 to 31 kilogrammes.

In speaking of the vessels which are made use of in this operation, M. Tukert has also omitted to describe their exact form; the principal vessel is not a jar, but rather a kind of crucible, round which the heat circulates, and which is surmounted by an iron dome, through the top of which the matter is introduced, after the crucible has been heated to redness. The success of the operation depends essentially upon the manner in which the fire is conducted during the sublimation. The combustible which is employed is turf, and, as M. Payssé has observed, there is none better adapted than this, when the object is to obtain a constant and at the same time moderate heat; this uniformity of temperature, during the thirty hours that the fire is applied in the furnace, is undoubtedly one of the causes which contribute the most to the success of the operation. Experience also confirms this opinion, according to the testimony of the workmen.

The red sulphurated oxide of mercury being once prepared, a large quantity of it is reduced to powder, in order to be converted into the vermillion of commerce. This preparation is still a secret in the possession of the Dutch; and yet there is no chemical work in which the process for obtaining it is not described; they merely direct us to reduce the cinnabar to powder, to wash it in water, and then to dry it. This means, which M. Payssé has frequently put in practice, has indeed always given him as the product a fine red powder; but it must nevertheless be admitted that it is not equal in beauty and lustre of colour to that of Dutch manufacture.

China

China furnishes painting with a kind of red sulphurated oxyde of mercury in powder (vermillion), which is in much higher estimation than the Dutch; its colour is the most beautiful red of an incomparable lustre; for some years past also the Dutch have been employed in imitating it. M. Payssé has seen some prepared, a very short time since, in the manufactures of that country, the process for which is another secret. This oxyde rivals that of the Chinese in beauty: he thinks even that in a short time it may be brought to the same degree of perfection.

Not having been able to procure any information respecting the means put in practice in order to imitate this particular preparation; suspecting however that the lustre of the sulphurated oxyde of mercury of the Chinese, as well as that of the Dutch, could be owing only to the more or less advanced state of oxygenation in which mercury exists in this compound; M. Payssé made an experiment: he took a hundred parts of Dutch red sulphurated oxyde of mercury; after having put them into a capsule of glass, sheltered from the rays of the light, he covered this powder with some cubic centimeters of pure water, using the precaution to agitate this mixture with a glass tube for the space of a month. After seven or eight days he saw the oxyde change sensibly, and assume a very pleasing tinge; during about twenty-five days the lustre of the red augmented gradually, and acquired the greatest beauty. Having perceived that the matter remained in the same state, and underwent no farther apparent change, he poured off the water, and dried the red sulphurated oxyde of mercury in the shade, and in a mild temperature. Having compared it in this state, when it was well dried, with that called the Chinese, and that of the Dutch manufacture, prepared by their

secret process, M. Payssé did not discover any sensible difference in either the beauty or the lustre of the red; so that this very simple experiment puts us in possession of a process of great advantage to the arts, particularly to that of painting, and of which the Dutch have long made a secret.

Wishing to know whether air and light alone could produce a similar effect on this sulpurated oxyde, M. Payssé disposed a hundred parts of the same substance, likewise in powder, in a vessel similar to the first, to the action of a bright light, for the space of more than a month: he took care, as in the former experiment, to renew the surfaces very frequently by agitation, in order to multiply the points of contact of this sulphurated oxyde with the air which served for its atmosphere; but instead of acquiring a more beautiful red, the sulphurated mercurial oxyde assumed a brick colour, inclining to a brown. There can be no doubt, according to this experiment, that the light has a very sensible influence upon this substance, and tends to reduce the sulphurated mercurial oxyde, by separating from it a portion of oxygene, as it does from most of the matters of this kind that are exposed to its immediate contact.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Feeding Sheep with Potatoes.

MR. John Forster, of Royston, in Herefordshire, has made a very successful trial of potatoes in the feeding of sheep during the winter. While the weather continued open

open and fair, the sheep were put upon turnips in the day, and home to the fold-yard at night, and had fresh straw given them. As soon as the frost prevented them folding upon turnips, trial was made of potatoes, which were put whole into troughs. The sheep ate very few for two or three days; after that time the only trouble was to keep them from running over the feeder. Three hundred ewes were supplied every morning with five bushels of potatoes, and fresh straw twice in the day. With this keep they did very well through the winter, sometimes on potatoes and sometimes turnips, as the weather permitted. The beginning of April the ewes and lambs were put upon three acres of Swedish turnips, which lasted them one month; they came home to the fold-yard every night. After that time they took the common field, and were folded every night through the summer. There was a bad fall of lambs that spring; some farmers lost their lambs in consequence of the ewes having but little milk, but Mr. Forster's fall of lambs was very good, 100 ewes brought him up 100 lambs, which were sold the following July for 14*s.* each, except forty of the best ewe's lambs, which were kept for stores. The May following Mr. Forster planted about five acres of potatoes, ploughed the land into one-bout ridges, spread long dung in the intervals, and planted potatoes on the dung; then, with a double-mould board plough covered up the plants, running a roll over the land to flatten the ridges. As soon as the plants were all up, a small swing plough was used to slice off a furrow from each side of the plants, which cast the mould into the middle of the interval, hand-hoed between the plants, and as soon as the weeds began to grow again split the ridges of mould with the double plough, which moulded up the plants completely. The produce two hundred bushels *per* acre.

Mr.

Mr. Forster's turnips failing last winter, potatoes were given to his sheep with nothing more than fresh straw night and morning through the winter, and at Lady-day the ewes and lambs were allowed to be in better condition than any flock in the neighbourhood. This may therefore be considered as a fair trial of potatoes, as the sheep had no other succulent food whatever; besides what the seven score of sheep consumed, as many potatoes were sold as paid 5 *l. per* acre. The land was ploughed as soon as the potatoes were taken up, and drilled with wheat at nine inches; crop as good as any that grew the same year.

Method of forming Roads on Clay or wet Bottoms.

First throw the soil from the sides, leaving a groove in the middle for the materials, beginning with kid or brush wood plentifully, then stones and gravel: if the gravel be very sharp and good, there is no occasion to round the road. Even a concave surface is found to answer very well; but where the materials are tender, it may be better to round it a little, but not so much as is frequently done, being often dangerous, and hurtful to the road, by obliging the carriages to keep in one track.

Dyeing.

A new method of dyeing cotton a rose colour has been discovered by M. Bruchmann, of Berlin. For this purpose he employs wild plumbs and muriatic or sulphuric acid.

New Metal in Crude Platina.

M. Brugnatelli writes to M. Van Mons on the subject of the new metal discovered by Messrs. Fourcroy and Vauquelin

Vauquelin in crude platina, (see the preceding volume of the present series,) that he had a long time ago obtained separately the substance which colours the solutions of platina. He diluted the solution of crude platina with eight or ten parts of water, and added a solution of muriate of ammoniac. The mixture did not at first become turbid, but after some minutes the sides and bottom of the vessel became covered with the red matter in shining particles.

Nickel.

M. Richter is at present occupied in a series of experiments upon nickel. In its pure state this metal is very malleable, nearly as brilliant as silver, and more attractible by the loadstone than iron. He asserts, that in the purest state in which it has hitherto been obtained, it still contains much copper. M. Richter has found a sure method of freeing it from this metal. The oxydes of the purified nickel are of a much more lively green colour than the ordinary oxydes, and their solution in ammoniac is of a very pale blue.

Metallic Oxydes.

M. Klaproth has found that the solutions of the metallic oxydes in the alkalies are as easily precipitated in the metallic state by other metals soluble in the same salts, as also by phosphorus, as the acid metallic solutions are. He has made a very ingenious application of this circumstance to the analysis of the ores of tin, according to the method which he has indicated in his *Beitraege*. In this process the tungstein is separated by zinc from the tungstate of ammoniac, in the form of black flakes.

Refractory

Refractory Quality of Magnesia.

M. Giobert writes, that he has found that magnesia communicates to all the earths with which it is mixed a refractory quality. Glass-makers crucibles, formed of any clay which is not very ferruginous, to which a third or half of magnesia of Bandisaro is added, resist the action of fire in the most perfect manner.

List of Patents for Inventions, &c.

(Continued from Page 80.)

ROBERT RAINES, the younger, of the town and port of Hull, in the county of York, Tanner and Glue-manufacturer; for a method of making and manufacturing of hard glue from tail, fins, and other parts of whale-fish. Dated November 22, 1804.

HENRY CLAYFIELD, of the city of Bristol, Wine Merchant; for a method of finding out of certain processes for separating the alkalies of potash and of soda from their sulphates or vitriolic salts, and from their sulphates or combinations with sulphur, as in soapers black ash and other similar compounds. Dated November 22, 1804.

JAMES SHARPLES, of the city of Bath, in the county of Somerset, Esquire; for certain combinations and arrangements of implements and mechanical powers, and certain principles and forms of tables useful for surveying. Dated November 24, 1804.

January 12, 1805.

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PROSPECTUS.

THE Advantages resulting to a Nation from an Acquaintance with its History are so obvious to every reflecting Mind, that it may be considered unnecessary to insist upon them: but were Authorities wanting to establish this Truth, the Opinion of Professor Robertson must be admitted to have great Weight. In the Preface to his History of the Reign of Charles the Fifth, he says, "No Period in the History of one's own Country can be considered as altogether uninteresting. Such Transactions as tend to illustrate the Progress of its Constitution, Laws, or Manners, merit the utmost Attention. Even remote and minute Events are Objects of Curiosity, which, being natural to the Human Mind, the Gratification of it is attended with Pleasure." This Observation may be applied with peculiar Propriety to LONDON, the Commercial Influence of which is so extensive, that there is not any Part of the British Dominions which is not interested in it, and bettered, in some Degree, by a Connexion with it.

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> So rich, so throng'd, so drain'd, and so supply'd,
> As London?—Opulent, enlarg'd, and still
> Increasing London! COWPER.

But though its stupendous Commerce and Mercantile Opulence are universally felt and acknowledged, the generality of Writers on the Localities of London have confined their chief Attention to the Narrative and Descriptive Departments; and, consequently, there is no Work extant in which the Origin, Progress, and present State of its Commerce, holds so prominent a Rank, as, from its Importance, it is entitled to.

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1805.

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